Gas Journal

INSTITUTION NUMBER

VOL. 298. 111th YEAR LONDON, JUNE 3, 1959 Nº 5003 PRICE 2/6

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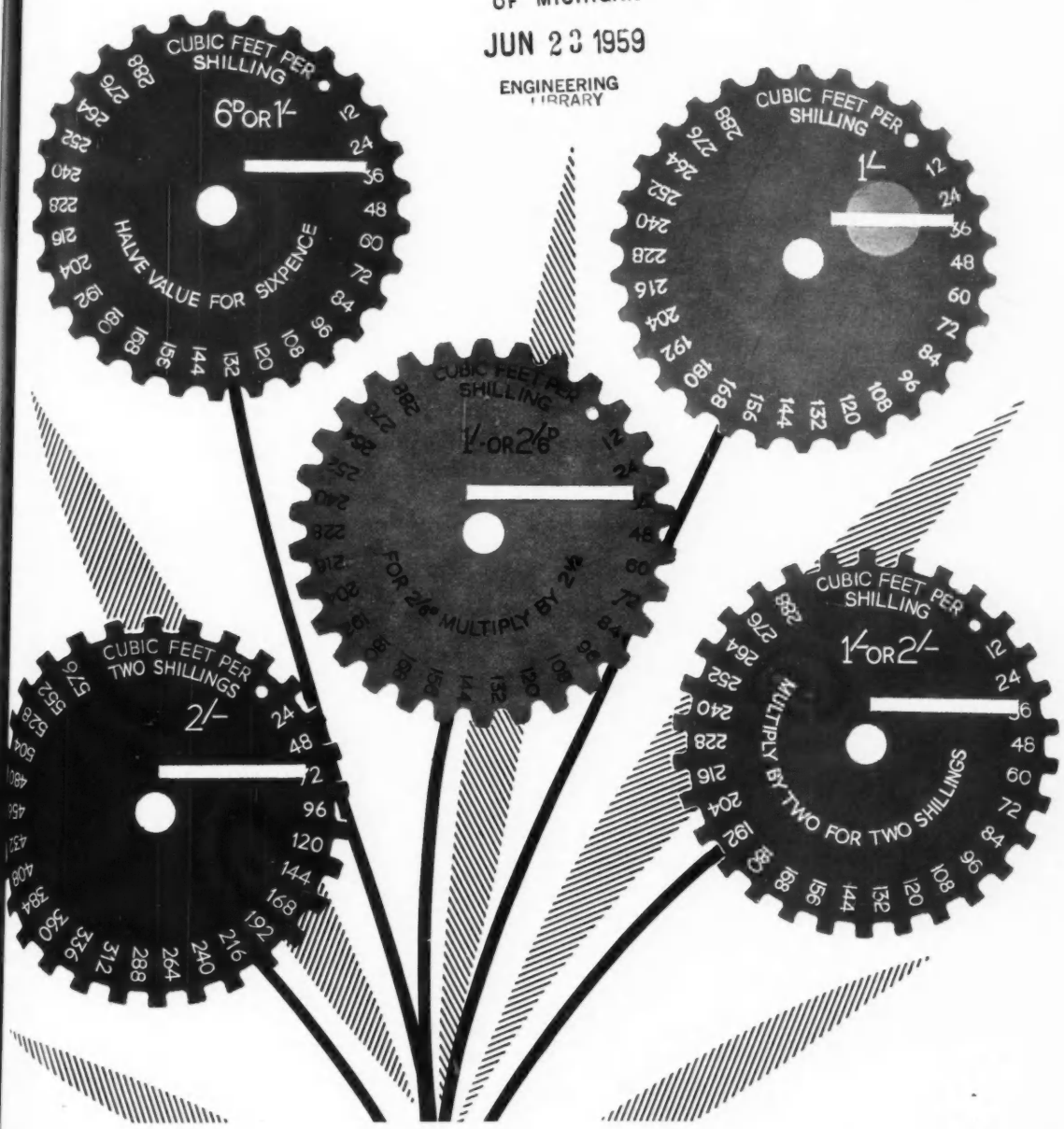

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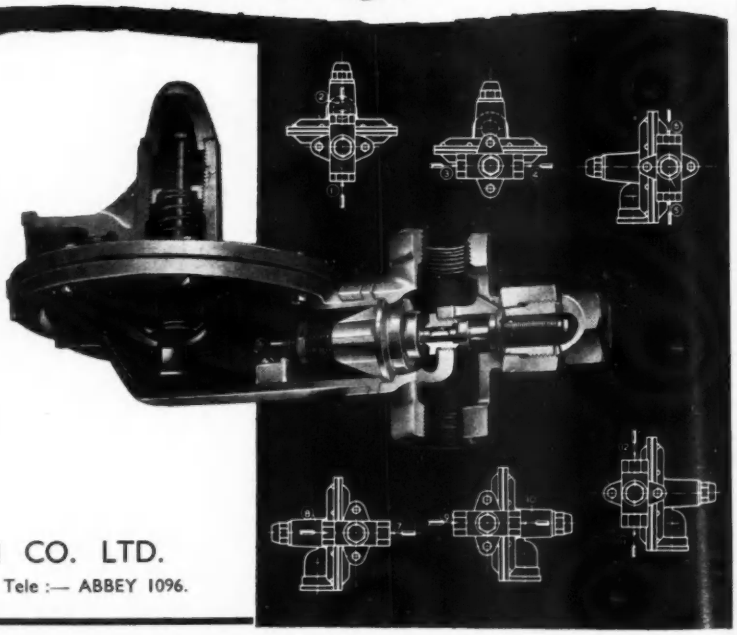

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Gas Journal

VOL. 298 *No. 5003* *JUNE 3, 1959*

IIITH YEAR

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Published by Walter King Limited,

11, Bolt Court, Fleet St., London, E.C.4

Telephone: FLEet Street 2236-7 **Telegrams:- Gasking, Fleet.**

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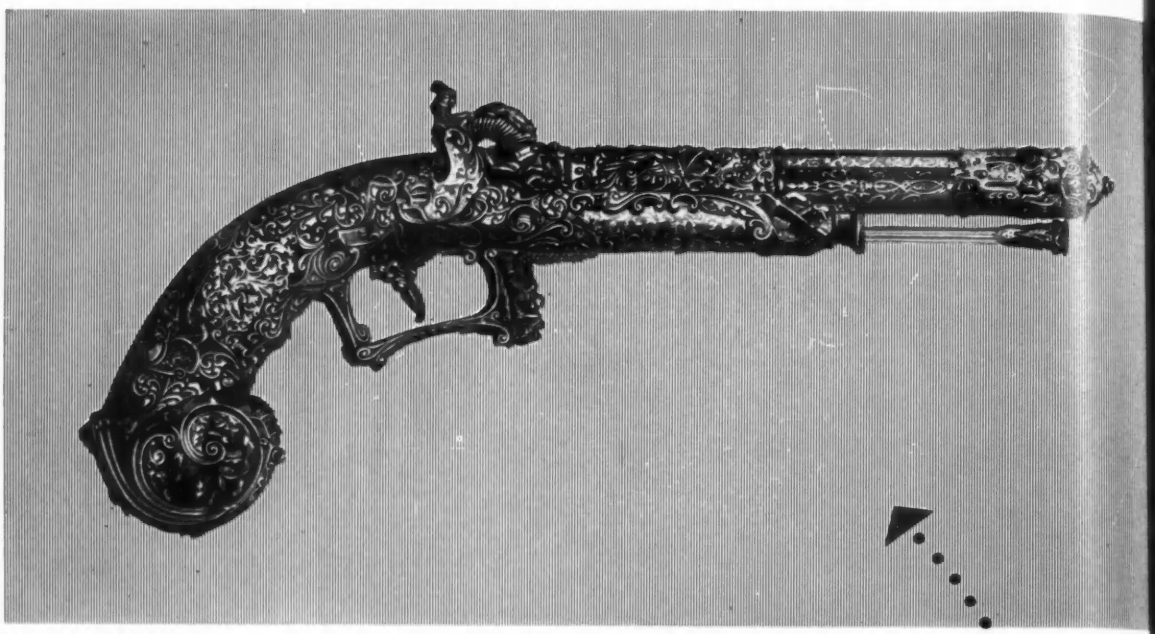

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something in common

They remind one of different worlds, the Spanish forged iron pistol of 1850 and the modern T.G. meter. Yet, they have something in common — both are the products of true craftsmanship. The pistol delicately engraved and inlaid with damascene, designed and made by Eusebio Zuloago of Madrid, is presented as a fine example of the gunsmith's skill. The T.G. meter epitomizes craftsmanship and the T.G. 'G' prepayment mechanism is accepted as the most modern precision movement on the market.
Something else in common, this Spanish pistol and a T.G. meter were both exhibited at the Great Exhibition of 1851.

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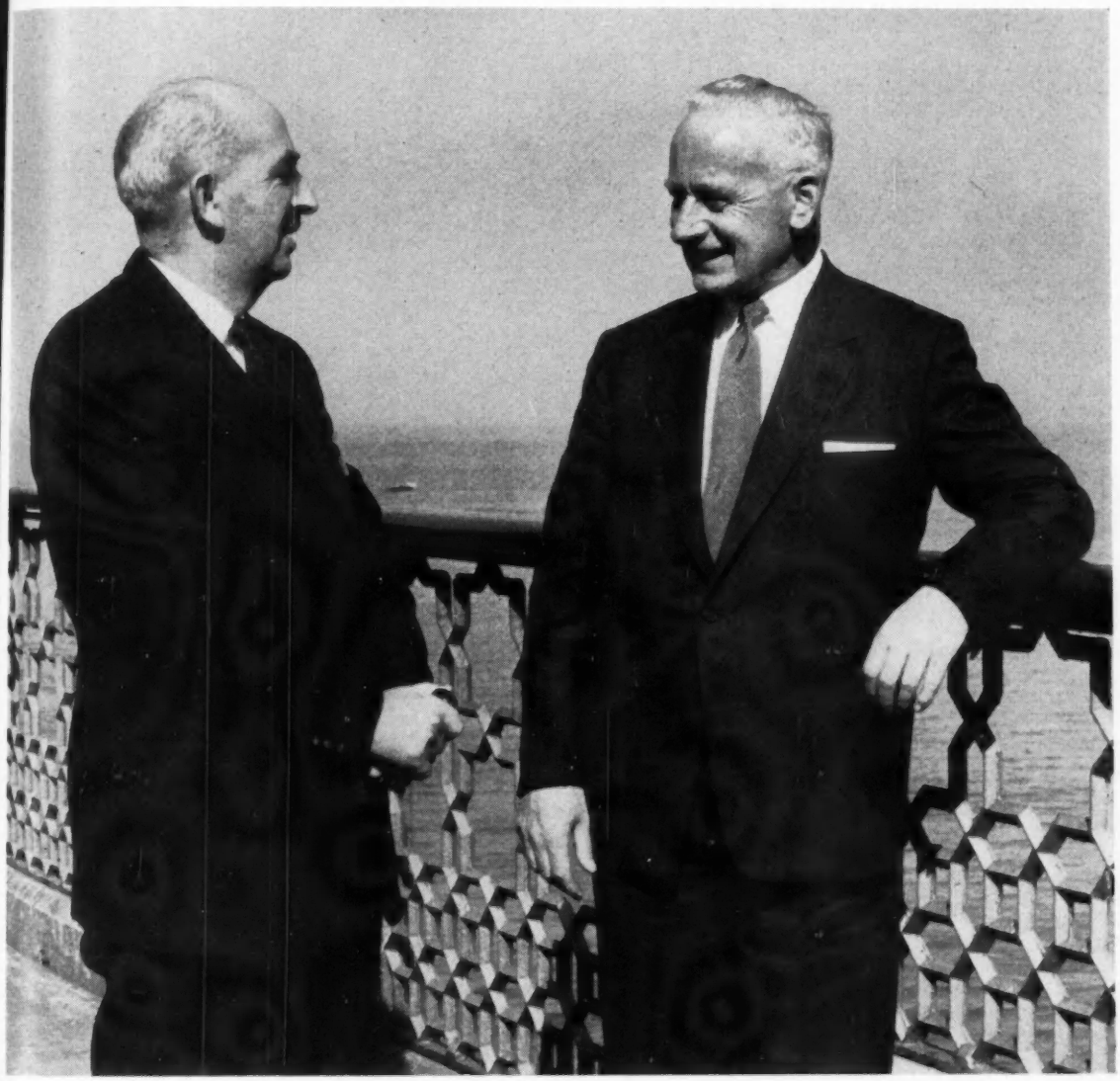
Institution of Gas Engineers

96th ANNUAL GENERAL MEETING



THE PRESIDENT AND PRESIDENT-ELECT

Mr. E. M. Edwards and Mr. D. D. Melvin at Llandudno

LLANDUDNO

Review of the meeting

IT would be difficult to imagine a conference venue more delightful than Llandudno in fine weather, or a meeting more successful than the 96th Annual General Meeting held there last week. Everything about it was right: The Pier Pavilion was cosily convenient; the amplification worked; the papers were up to the traditionally high standard; speakers seemed free from that dæmon which makes them talk too long (indeed, we noticed none of the buzzers and flashing lights which are usually employed to curb verbosity); and everything ran like clockwork. Best of all perhaps, the sun shone, permitting the inevitable cluster of delegates who always congregate round the entrance to the hall to gaze across the sparkling bay while gossiping of this and that.

It may not be generally appreciated that no matter how much they may try to sense the majority opinion of any conference of this nature, the scribes who represent the various technical journals suffer the disadvantage of literally seeing the proceedings from a different viewpoint. By tradition they lurk in the very shadow of the stage, peering hopefully up at such members of the platform party as come within their limited field of vision. Of some things, therefore, they see nothing at all, while of others they see, at times, too much.

This was our predicament at Llandudno. As far as we were concerned the Council members who sat behind the President's table did not exist; but of the 'front line' we had a worm's eye view of startling brilliance, softened slightly by the aura of maidenhair fern which surrounded each face. There sat Sir Harold Smith, looking inscrutably through his haze of pipe smoke; there sat Mr. D. D. Melvin, gazing keenly this way and that; there sat Dr. W. T. K. Braunholtz, a graven image, benevolent of feature, credited with powers not far removed from magical. And there, too, sat the President, Mr. E. M. Edwards, whose sun-tanned brow seemed to be as tranquil and majestic as the Great Orme's head which loomed so impressively to one side of Llandudno bay.

Just how placid and relaxed Mr. Edwards really felt we do not know, but everyone present will surely testify to the unruffled charm with which he conducted this important meeting and to his unfailing courtesy to all concerned. It is obvious that E.M.'s reticence cloaks a fine brain and a dogged determination—otherwise he would not have reached the eminent position he holds today—but the modesty is genuine enough and that is no doubt one of the reasons why all those who spoke of him during the meeting did so with affection as well as respect.

The meeting opened in traditional

fashion with a welcome from the local authority. In this case, however, Councillor Harold Neville, J.P., the Chairman of the Llandudno District Council, had an additional and more important duty—that of welcoming the Institution not only to Llandudno, but to Wales. 'We hope,' he said, 'that it will not be another 20 years before you return once again to Wales'—a sentiment which must surely have been endorsed by all present.

A particular pleasure of the meeting was the presence of so many representatives of overseas gas associations. Those welcomed by the President were, from Australia, Mr. W. S. McGowan, Member of Council, the Australian Gas Institute, and Mr. W. H. Shedden, Past President, National Gas Association of Australia; from Belgium, M. P. Dorzée, President, Royal Association of Belgian Gas Engineers, and M. R. H. Touwaide, Secretary, the International Gas Union; from Denmark, Dr. E. Beck, of Odense, and Mr. N. V. Steenstrup, General Manager, Danish Gas Company, Odense; from France M. Y. Quéret, Vice-President, French Gas Association, M. A. Renauldon, Gaz de France, and M. M. Vicart, Société Nationale des Pétroles d'Aquitaine, Paris; from Hong Kong Mr. H. W. G. McLaren, Hong Kong and China Gas Company, and Mr. T. Spikins, Manager, Hong Kong and China Gas Company; from Singapore, Mr. F. B. Oliver, Deputy City Gas Engineer; and from Sweden, Mr. B. M. Nilsson, President, the International Gas Union.

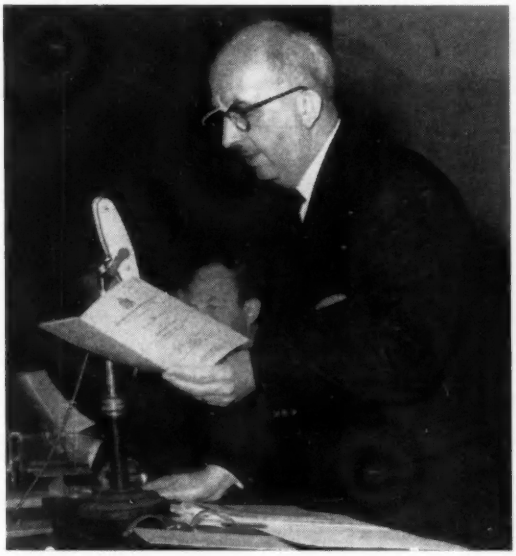
In addition to these overseas members, visitors and delegates there were present official representatives of the Government of the United States, Mr. E. N. Cooper, and of the U.S.S.R., Dr. A. Petrusevitch.

The Secretary reported that greetings had been received from Dr. V. da Bias, President of the Italian Gas Association, Dr. M. Boselli, Past President of the International Gas Union, and from Colonel H. Zollikofer, former Secretary of the International Gas Union, who is an honorary member of the Institution; in addition good wishes had been sent by the Gas Associations of Austria, Czechoslovakia, Holland, Spain and Switzerland.

The results of the ballots for the election of Officers, Auditors and Ordinary Members of Council were as follows:

President, 1959-60: Mr. D. D. Melvin, Member, Scottish Gas Board. Vice-President, 1959-61: Mr. T. C. Battersby, M.B.E., General Manager, Watford Division, Eastern Gas Board. Auditors, 1959-60: Sir Harold Smith, Chairman, the Gas Council, and Mr. P. D. Davey, of Wood, Drew & Company, London. Honorary Secretary, 1959-60: Mr. G. E. Currier, O.B.E., Deputy Chairman, North Eastern Gas Board. Ordinary Members of Council, 1959-62: Mr. W. R. Branson, Deputy Chairman, West Midlands Gas Board, Birmingham; Mr. M. S. Gaskill, Technical Director, West's Gas Improvement Co., Ltd., Manchester; Mr. L. F. Randall, Commercial Manager, East Midlands Gas Board, Leicester; and Mr. J. G. Tilley, Group General Manager, Huddersfield-Halifax Group, North Eastern Gas Board, Huddersfield.

★



Mr. E. M. Edwards, Deputy Chairman of the Wales Gas Board, President of the Institution 1958-59, opens the meeting.

★

New Honorary Members

It was reported that Dr. A. Parker and Mr. C. Dempster had been elected Honorary Members. Acknowledging this distinction Dr. Parker recalled that he had been associated directly and indirectly with the gas industry since 1919—a period of 40 years. Since he had left his appointment doing research directly for the Institution, he had maintained his interest in the industry, and he was glad to see how well the industry was progressing in these somewhat difficult and competitive times.

The names of the District Members of Council nominated by the District Sections of the Institution and affiliated District Gas Associations, for the year 1959-60, were as follows: Mr. W. F. Edwards (Port Talbot), Wales and Monmouthshire; Mr. A. Field (Penrith), North of England; Mr. J. S. Fox-Andrews (Derby), Midland; Mr. R. J. Gavin (Royston), Eastern; Mr. J. D. Grant, M.A. (London), British Junior Gas Associations' Joint Council; Mr. W. S. Johnston (Glasgow), Scottish; Mr. A. H. Nicholson (Blackburn), Manchester and District; Mr. G. F. Oliver, M.B.E. (Bath), South Western; Mr. A. Robin (Belfast), Irish; and Mr. R. F. Robinson (Watford, London and Southern.

Scrutineers of the ballots selected

The best-laid plans . . .

It was an unkind twist of fate that caused the publication of the Institution Number of the 'GAS JOURNAL' to coincide with further restricted working in the printing trade. This has caused our plans to be seriously curtailed and has resulted in an issue substantially reduced in size and variety; this applies particularly to the editorial matter which required late setting. For this we apologise, pointing out that although as publishers we are non-combatants in the dispute, we no less than our readers must be numbered among the injured parties. We shall of course publish the remainder of the Institution material as soon as the printing position permits.

for the ensuing year were Mr. M. S. Gaskill, Mr. J. D. Grant, Mr. L. F. Randall and Mr. R. F. Robinson.

Medals and prizes

The President then presented the following medals and prizes:

Institution Gold Medal, 1958: To Mr. W. J. Bennett, Mr. K. J. D. Brady, and Mr. E. W. G. Dance, for a paper on 'Further Experiments with Shared and Individual Flues for Gas Appliances,' read at the 24th autumn research meeting of the I.G.E. on November 19, 1958.

H.E. Jones London Medal, 1958: To Mr. D. Beavis, for his paper on 'Work Study: Three Years' Progress at Edinburgh,' read at the 95th annual general meeting of the I.G.E., May 15, 1958.

Institution Silver Medal, 1958: To Mr. E. E. Pickering for his paper on 'Clean Air and Clean Water, and the Gas Industry,' read at a meeting of the Midland Section of the I.G.E. on October 31, 1958.

Institution Bronze Medal, 1958: To Mr. T. Bryan, for a paper on 'Electrical Economy in Gas Works,' read at a meeting of the Midland Junior Gas Association on March 4, 1958.

William Dieterichs Memorial Prize, 1958: To Mr. W. E. Francis, for his paper on 'The Design of Air Blast Tunnel Burners,' read at the 24th autumn research meeting of the I.G.E. on November 18, 1958.

Presidential address

There followed the Presidential Address, published in last week's issue. Mr. Edwards interpreted his task as being to review not only the trends in manufacture and utilisation, but also the responsibilities of the Institution and the situation as it affects the young engineer. We noted with particular pleasure the emphasis he placed on the need for brevity in the technical papers, reports, and contributions to discussions; and we liked his aside to the effect that the first question a man contemplating writing a report should ask himself is whether his report is really necessary. Perhaps it was this word of warning which helped to ensure remarkably crisp and tidy contributions to the discussions which followed.

Mr. Edwards sees in the future the high-pressure gasification of coal and oil in a relatively small number of very large plants situated principally near the coalfields, oil refineries and major ports. The processes now being developed offered the promise of lower production costs of gas low in carbon monoxide and sulphur; and the high pressures at which the gas would be produced would enable it to be transmitted economically upon a wide scale, through a national or semi-national gas grid. These and other developments would naturally take some time to accomplish, as also would the development of synthesis processes and potential chemical products.

'In the conditions of intense competition existing in the fuel market,' he added, 'the gas industry must actively pursue all means of increasing gas sales, and of reducing costs, consistent with maintaining a good service to consumers and fair treatment of employees.'

Mr. W. Clarke Jackson and Mr. J. H. Dyde, who respectively proposed and seconded the vote of thanks to the President for his address. Both have had a particular experience of Mr. Edwards, the former as his mentor, in his days as an engineering pupil, the latter as chairman of the Productivity Team which visited the United States and of which Mr. Edwards was a member.

The President's 'old boss'

It was particularly appropriate that the vote of thanks for the Presidential Address should have been proposed by Mr. W. Clarke Jackson, who had almost certainly known the President longer than anyone else present. He recalled their relationship: 'Your President came to me as a young and small boy. His then object in life was more or less to attain in due course a very worthy position as chief clerk. It did not take me long to appreciate the fact that this young lad showed a touch of brilliance in everything that he was given to do, and that it would be a calamity to continue him in office work. As a result, and after consulting with his father, it was agreed that I take him on as a gas engineering pupil, in which capacity he continued to show his brilliance, and today I am proud indeed to see him taking his rightful place as your President and to have the honour of proposing the vote of thanks to him for his most excellent and stirring Presidential Address. Although in his rise to eminence it is a case of the pupil outshining the master, he has retained and deepened a very sincere and happy friendship with his old boss.'

Memories of America

Seconding the motion, Mr. John Dyde had his own comment to make on his experiences with Mr. Edwards: 'It was during my own year in the Presidency that I really came to know Edward Morgan Edwards,' he said. 'We came together as members of the Productivity Team which visited the United States in 1951. You cannot work and live together as closely as we did on that assignment without getting to know something about a man. Eddie, as he affectionately became known to us, soon revealed himself as a most invaluable member of that team and endeared himself to us all as a most likeable and generous character. But what a glutton he was for work! He really left us all standing, and I believe that his colleagues in the Wales Gas Board, and over the last year the Council and the staff of the Institution, have found that he has not changed a bit. You really should have seen him at work on one of the many interviews that we had with our American colleagues. You could not have helped but admire the quiet yet firm and persistent way he sought out

facts and sized up situations. He was never content with fragments and scattered pieces of information. He wanted the whole story, and, by God, he got it! If you trace the development of the Wales Gas Board, you will find that they were first in the field in the United Kingdom in adopting, and indeed in improving, many of the advanced American methods. For instance, there were the pipelining techniques of the Welsh Grid, the use of liquid petroleum gases, and I am sure that it is true to say that the introduction of these and many other methods are directly attributable to our President.'

Both speakers complimented Mr. Edwards on his address. 'He has given of his personal experience in his sound observations respecting general administration, careful planning of work, the effect of capital charges, of wise delegation of duties, and a sound sales policy,' said Mr. Clarke Jackson. 'His advice commands our careful attention and represents the result of his own sound and successful career.' Mr. Dyde summed up: 'Our President has said the right thing at the right time.'

Friends from overseas show their appreciation of the Presidential Address.

Continental atmosphere

For the remainder of the opening session a Continental atmosphere pervaded the meeting. We heard 'Research Programme of the French Gas Industry within the Framework of the Industry's Technical Evolution,' by R. Delsol, Director of Research and New Techniques, and A. Renauldon, Assistant Director of Research and New Techniques, Gaz de France, and 'Putting to Work the Natural Gas Deposits at Lacq,' by J. Fouchier, Production and Sales Manager, and M. Vicart, Engineer, Commercial Division, Société Nationale des Pétroles d'Aquitaine.

The first paper gave a concise account of technical problems arising in the French gas industry as a result of its development, which is due mainly to the economic position, availability of raw materials, and new sources of energy. The authors then described the solutions found for these problems in the various fields of activity of the gas industry by the Department of Gaz de France for Research and Testing of New Techniques. The problems still to be solved were called to mind, together with future prospects.

We have read a good deal about the Lacq natural gas deposits in recent times and it was extremely interesting to study this informative account. The need to increase France's energy resources has led to the working of these deposits because of the size of the reserves and despite their very unfavourable characteristics. This involved the solution of very difficult technical problems, and contributed to the revival of the French gas industry. The most remarkable innovations were the installation of a purifying plant of very high capacity, construction of a long large-diameter high-pressure distribution grid, and the creation of an underground gas reservoir between the works and the supply grid.

So ended the first morning and we repaired to the Winter Gardens for the President's Luncheon, which is reported on a later page.

Hong Kong and Denmark

With the geographical bit between its teeth the Institution turned to Hong Kong and Denmark, when members reassembled. The first of the two papers presented and discussed was by T. Spikins, Manager of the Hong Kong and China Gas Company. The present development of gas distribution in the United Kingdom with the construction of large efficient works pumping gas into a grid system of high-pressure gas mains, resulting in the closing down of smaller and/or less efficient works, is being mirrored in Hong Kong on a very much smaller scale. Such small-scale efforts offered interesting points of comparison with the major projects in Britain, particularly where factors peculiar to Hong Kong were taken into account.

Following a brief history of the company, a study was made of the main Ma Tau Kok construction, which started in 1954. A description of the cross harbour main project was followed by a discussion of the factors that determined the choice of gas-making plant to replace that being put out of commission. The new plant and its attendant problems were described. In conclusion, administrative matters, the installation of mechanical accounting, and staff problems were mentioned in order to complete the picture of the changes effected by the company during the last few years.

This interesting paper was followed by 'The Use of Propane/Butane for Gas Making in Vertical Retorts' by N. V. Steenstrup, General Manager and Chief Engineer of the Odense Works of the Danish Gas Company.

The paper described the use of propane/butane for gas making by passing, or so-called 'purging,' the vaporised propane/butane through the red-hot coke bed in vertical, primarily intermittent, retorts during the steaming period. A mixture of propane/butane and superheated steam is introduced into the retorts through the normal channels for steaming. In the retorts, the propane/butane is reformed to a gas enriching the water gas to a purge gas that has a specific gravity of 0.45 and a calorific value of approximately 340 B.t.u. per cu.ft. Thus, the principle allows for a higher addition of purge gas than of water gas from steaming under normal operation.

Carbonising capacity increased

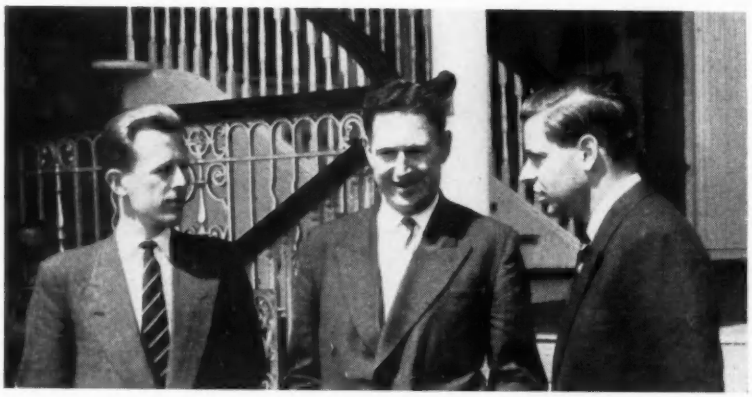
The author explained how by slender means, the carbonising capacity of the retorts was increased by 20%, and yet allowed for further addition of 10% of propane/air or 12% of propane/producer gas. Propane purging offered several advantages compared with other methods of meeting peak loads, such as low specific gravity of the purge gas, good combustion characteristics, easy handling, great flexibility, high extra capacity, low installation cost, facilitating resetting programmes, eventually postponing for

a year or two the lighting up of a new oven, and in real emergency, enabling the purge gas to be boosted to perhaps 35% of the final gas. But the propane purging system had at least the drawbacks of low efficiency (70 to 75%) and high carbon monoxide content. Nevertheless, as the propane purge was only intended to cover 1 or 2% of the total annual load, these deficiencies were of less significance.

While delegates had been keeping their noses to the grindstone their ladies had been introduced to the wonderful North Wales scenery by means of a motor coach tour. But they joined their better halves later that evening at the Arcadia where a civic reception was held by the Chairman of the Llandudno U.D.C. and, later, all present tripped the light fantastic and were entertained by a cabaret.

Speaking personally, we found attendance at the hall at 9.15 the following morning something of a strain but, in company with a large percentage of members, we found the effort rewarding in that we were treated to the rare spectacle of an author presenting, and members discussing, a non-existent paper. The fact is that Mr. J. D. C. Woodall, Sales Manager of the South Eastern Gas Board, had a spot of bother with his paper on 'The Influence of Modern Techniques of Gas Manufacture and Improvements in Appliance Design on the Development of the Domestic Load' and the work is still in the crannies of his fertile brain, or somewhere. At all events we were given a synopsis, plus some rather impressive graphs, and perhaps the most lively and relaxed discussion of the meeting.

Mr. Woodall paid scant attention to the title of his ghostly paper and concentrated on showing how the creation of imaginative tariffs had made space heating by gas really competitive. He was well qualified to speak on this subject since, as Mr. Gordon Madge said in the ensuing discussion, the South Eastern Gas Board's two-part tariff had been one of the most outstanding acts of faith in the industry's history. It was also this speaker who described Mr. Woodall as a 'professional optimist', and indeed some doubt was cast on his hopes of selling half a million gas fires next year. But the author received solid support on most points. An exception was the future of coke, Mr. Woodall envisaging an all-gas future, and Mr. J. G. Tilley (North Eastern) prophesying a worthwhile market for solid smokeless fuels for years to come. Worthwhile points were made concerning ap-



Pictured here are the recipients of the Institution Gold Medal, 1958. From left to right: Mr. W. J. Bennett, Mr. K. J. D. Brady, and Mr. E. W. G. Dance. The medal was awarded for their paper 'Further Experiments with Shared and Individual Flues for Gas Appliances.'

The William Dieterichs Memorial Prize, 1958, was awarded to Mr. W. E. Francis, seen here with Mr. E. M. Edwards, for his paper on 'The Design of Air Blast Tunnel Burners.'

Mr. D. Beavis, who received the H. E. Jones London Medal, 1958, for his paper read at the 95th annual general meeting last year.

The Institution Silver Medal, 1958, was awarded to Mr. E. T. Pickering for his paper on 'Clean Air and Clean Water—and the Gas Industry' which was read at a meeting of the Midland Section of the I.G.E. Mr. E. M. Edwards is on the right.

Above is Mr. T. Bryan, who was awarded the Institution Bronze Medal, 1958, for his paper read to the Midland Junior Gas Association.

pliance design (Why not make use of the Council of Industrial Design? asked Mr. T. E. Tyrrell), payment for gas by banker's order and other semi-painless methods, and lessons to be learned from the success of oil in the domestic space heating field.

After a general meeting of contributors to the Benevolent Fund, we heard two papers which dealt, appropriately enough, with aspects of the gas industry in Wales.

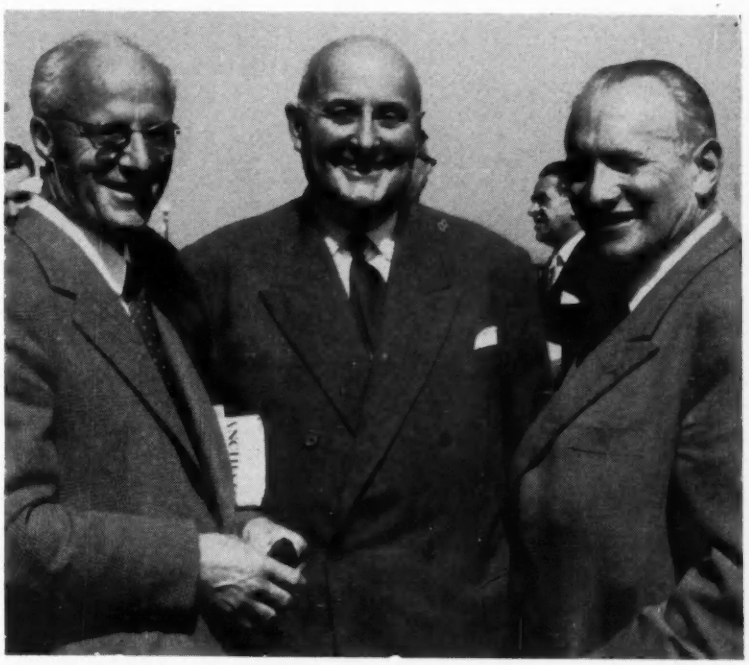
Integration in Wales

First came 'Sources of Grid Supply in Wales' by S. L. Wright, Gas Engineer and Planning Officer (Production) to the Wales Gas Board. The author referred to the cessation of gas manufacture by individual gas undertakings in Wales, in favour of gas purchased from external sources, and introduced considerations affecting those supplies. Having reviewed the development of coke oven gas supplies for the South Wales gas grid, he gave descriptions of the plant installed at the Pontypool and Aberavon works and of the scheme for utilising methane drainage from three collieries in the Afan Valley. Estimates of gas availability and demand were compared and reference made to lines of future development. The steps leading up to integration based on three main supply stations were stated, and details were given of the problems associated with the recovery of methane from the Point of Ayr Colliery, and the operation of the methane reforming plant. Estimates of gas availability and demand were compared, and plans for future development were outlined.

Pipeline methods

The second paper, by Mr. W. T. Hird, Distribution Engineer and Planning Engineer (Distribution), Wales Gas Board, dealt with the transmission of gas in Wales and, in particular, with developments since 1953 in the design and construction of pipelines to operate at pressures up to 250 lb. per sq. in. The factors that led to the introduction of an American pipeline spread were discussed and a description given of the construction methods used. Mr. Hird referred to the costs of construction and to the application of pipeline methods to the construction of small-diameter pipelines. Particularly interesting were the financial and commercial results of the construction work described, and the paper concluded with a section dealing with possible future developments in gas transmission in Wales.

Thus ended the second morning's business. In the afternoon a fleet of motor coaches took members to a variety of works, described elsewhere in this issue, while the ladies went sight-seeing at Penryhyn Castle, Bangor, and Bodnant Gardens, Taly-Cafn.



J. Castle (North Western) with guests from France—M.M. Quéret and Renauldon.

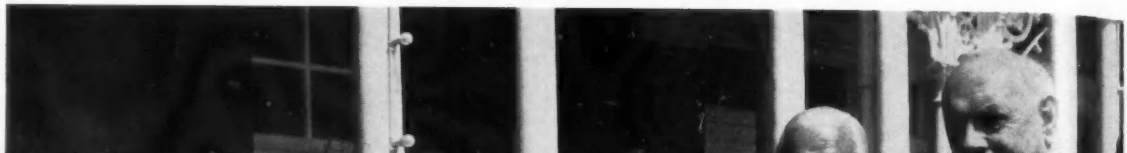
The following morning we turned our attention to the thorny problem of coke, to be precise, 'Coke Preparation and the Solid Fuel Market.' The authors, J. R. Grey and R. J. Newman, are respectively Engineering Assistant and Technical Assistant at Watson House, and in their paper they suggested ways in which improvements in coke preparation might be effected, analysed the causes of common complaints, and emphasised the need for a sound sales service. Mr. Newman, who presented the paper, concluded: 'It is in the hands of the gas industry whether coke sales expand or contract. The appliances for coke are to hand, the right type of coke can be made. Given a suitably equipped sales force, we believe that there is no reason why the future for coke sales should not be a happy one.'

Eminent contributors

Throughout the meeting no paper was graced by more eminent contributors to the discussion. Chief among the participants was Sir Harold Smith, who had been struck by the authors' suggestion that today, the industry was faced by a situation similar to that which existed some 30 years ago. Sir Harold suggested that we should ask ourselves whose fault it was that such a similar situation existed. Whether the gas industry should be all-gas or gas and coke the customer would decide, he said, but we must see to it that the industry was not 'moaning' like this in another 30 years. For the rest Mr. W. R. Branson talked about the virtues of mobile coke demonstration vans, Mr. W. L. Rushton (Robert Cort), Mr. W. A. P. Hoskin (Barnsley District Coking Company) and Mr. T. W. Austin (Woodall-Duckham) discussed such matters as screening and firebar spacing, while Mr. D. G. Rose asked the engineers to 'Keep it clean!'

Reforming at Romford

So to the rather topical paper on 'The Romford Gas Reforming Plant' by J. Burns, Chief Engineer, and E. R. Stewart, Romford Station Engineer, North Thames. It is well known that two large refineries situated at Shell Haven and Coryton provide a valuable source of raw material for supplementing the Board's gas supplies. Further, the Board can see the possibilities of accepting natural gas into Canvey, where the Board owns land with deep water berthing on the river. The paper described the provisions made to accept the actual and potential raw materials into the Board's framework of gas manufacture. The plant ultimately selected was described in some detail, and operating results over a



J. Hunter-Rioch (Cambridge), M. F. Lady, David Fulton (Scotland), D. Beavis and G. J. B. Cox (both Edinburgh) and W. H. G. Roach (William Press).

period of some nine months were included.

Admirably presented by Mr. Stewart, the paper clearly made a considerable impression, and both Mr. W. K. Hutchison and Dr. A. E. Haffner paid some handsome compliments. Other contributions came from the chief contractors (Mr. G. V. C. Davies, Humphreys & Glasgow Ltd.), from the refinery and from the authors' own Board. Dr. Burns brought proceedings to a close with a characteristic flourish.

Purification at Cardiff

Lastly, J. Powdrill, General Manager and Engineer, Cardiff Undertaking (how nostalgic one feels at the sight and sound o some of the Welsh titles!) presented a first-rate paper on 'Operation of Liquid and Gastechnik Purification Plants at Cardiff.' The paper gave details of two new types of gas-purification plants, to meet the particular requirements at the Cardiff undertaking. A full description of each plant was given with details of operation, costs and information from plant experience. Part I dealt with a liquid plant and its development to ensure complete reliability of H_2S removal, to statutory requirements, operating direct into holders. Part 2 not only dealt with a Gastechnik tower installation operating very successfully with the removal of H_2S to statutory requirements, but, also, a new method of recovering high-quality elemental sulphur, and an oxide pellet-making plant of original design.

It only remained for everyone present to say thank you to those who had made the meeting a memorable one. The traditional omnibus vote of thanks was entrusted to Mr. W. K. Tate, Director of Thomas Glover & Co., Ltd., and a past president of the Institution. With enviable verbal dexterity he succeeded in including everyone in his remarks in the shortest possible time and with the greatest possible charm.

And that, so far as the business of the meeting was concerned, was that. There remained a superb tour of Snowdonia, enjoyed by all concerned, and, for many, a somewhat leisurely journey home. That the Llandudno meeting will go down in the annals as one of the most enjoyable the Institution has had in its long history, there can be little doubt. For the President, for the Wales Gas Board and indeed for Wales itself, it was something of a triumph.

H. Butters (N.W.G.B.), W. A. Lloyd-Dodd (S.G.B.) and B. G. H. Clegg (S.G.B.).

Traditional gesture at President's Lunch

Mr. Mervyn Jones speaks of 'E.M.'s total dedication to industry'

IT is a pleasant custom of the Institution that its Official Luncheons should conclude with a toast to the President and that the toast may retain a measure of informal personality through its omission from the menu card. As well able as any we know to attune his words to such a tradition is the Chairman of the Wales Gas Board, Mr. T. Mervyn Jones, who last week proposed 'The President.'

MR. MERVYN JONES said he was honoured to follow the tradition that the toast to the President should be proposed, shortly and informally, as it would be, by his senior board colleague.

Anglo-Welsh co-operation

'E.M.,' as they had heard, was trained in Wales (South) by a Scotsman and early came to Wales (North), where, propelled by his own enthusiasms and a motor bicycle, he brought technical efficiency to the industry in difficulties only matched by the beauties of Snowdonia and Gwynedd. Honeymooning here in Llandudno saved him from lapsing to England (West Midlands)—not the least of the benefits of that propitious occasion. After a short sojourn in England (South-East) he returned to Wales (South) to pioneer collaboration between the gas and the steel industries in the latter's Mecca of Port Talbot.

Active in the councils of the industry, and especially in labour relations, nationalisation saw him as one of the founder whole-time members of the board. The present month had been a notable one for him for it concluded his devoted and distinguished year of office and marked his appointment, to the great pleasure of all, as Deputy Chairman. Of their original member trinity—he meant, of course, the players, not the gentlemen—it used to be said that the first expected everything to be done yesterday; the second expected everything to be done for nothing; and the third expected everything to be done perfectly. 'E.M.' was the last one.

Total dedication

The Institution for this last year, they as a board for the last ten years, and the industry for upwards of forty-one years, had seen him bring to the duties of his office that care and concern in tackling any job that came his way; that total dedication to the gas industry and its best interests; that infinite capacity for taking pains on its behalf; that restless searching the world over for new and better techniques. Butane-air in Britain, the technical backing of high-pressure steel pipe lining, the development of methane drainage and its reforming were but a few of his pioneer works. Finally, that quiet manner that cloaked dogged determination. For all these the Institution had reason to thank him.

MR. BENGT M. NILSSON (President, International Gas Union), proposing the toast of 'The Institution,' expressed the thanks of the company to Mr. E. M. Edwards for the opportunity to meet in Wales, that part of Great Britain well known all over the world not only for music and poetry, glorious views of mountains and sea, but also for coal. The last word would perhaps remind them of the real reason why they were here—to bring together gas men not only from Great Britain, but also from other countries and give them an opportunity to discuss technical questions of the industry with the object of promoting its progress.

The last ten years had given all those occupied in the gas industry many difficult problems to solve. Although the various national gas industries might show wide differences in structure, in general they were faced with the same basic problem—namely, to give their works sufficient flexibility to meet the more and more flexible demand and to achieve a sound equilibrium between supply and demand. Another very serious question was the coke market, and one must in weak moments ask if solid fuels would not be 'out' in long-term planning for house heating. On the other hand, here in Great Britain coke could be the solution of the clean air problem.

Flexible units

The answer to some of the questions had been to improve the production side by introducing flexible units complementary to the conventional retorts and coke ovens. One of the leading nations when it came to solving the problems had been Great Britain. Apart from gasification there was the very bold experiment of bringing liquified natural gas to London. The outcome of that experiment might have decisive importance for the solution of part of the energy problem in Europe.

Almost everything that had already been done in the gas industry and was necessary for the future was dependent on the initiative, power and skill of its engineers. Therefore, the work of the Institution was of utmost value to the British gas industry and also to gas men from other countries. They also benefited from that work, thanks to co-operation through the International Gas Union and other international bodies. Extremely good results had been achieved by the Institution since 1863 under the direction of many clever gas men, and not least during the past year of Mr. Edward's presidency. He, Mr. Nilsson, was sure the traditions would be continued in the future to the benefit of the industry.

The PRESIDENT, in reply, said he understood this was the first occasion on which Mr. Nilsson had visited a gas association outside his country since he became President of the International Gas Union. Those who had had the pleasure of knowing Mr. Nilsson for some years realised full well how admirably he was fitted to carry the responsibility of the great office he now held.

I.G.U. lessons

In September last a large number of representatives of the gas industry in Great Britain had the pleasure of attending the International Gas Conference in Rome. They all learnt a great deal—some people learnt from what we said and we learnt a great deal from others. It was a most successful conference. In 1961, the next International Gas Conference would be held in Stockholm; and he assured Mr. Nilsson that in all the arrangements for it he would have the full and absolute support of the Institution.

The programme this week was a little unusual because of the number of papers from friends and delegates abroad. They had papers from Denmark, France and Hong Kong. In November last there was a paper from the U.S.S.R. Now this was not a conference of the International Gas Union, but as one lived and progressed one appreciated more and more the great value of an interchange of views between men of different countries, because, quite apart from the fact that there should be no barriers between technical men, the interchange of experiences and the friendships formed in time led to a better common human understanding.

Amendments to Charter

This was not the occasion to speak in technical detail of the developments that had taken place and were taking place in Great Britain, but there was already evidence from the pattern of events in the coalfields that the gas industry here, provided they acted with energy and determination, was going to play a much more important part in supplying the fuel needs of the country. Technical work and investigations were proceeding rapidly, greater co-operation was developing, and later on today they would be considering certain proposed amendments to their Royal Charter and to the Education Scheme so as to make better provision for the future.

Concluding, Mr. Edwards said: 'Mr. Nilsson has in a very kindly and encouraging manner associated my name

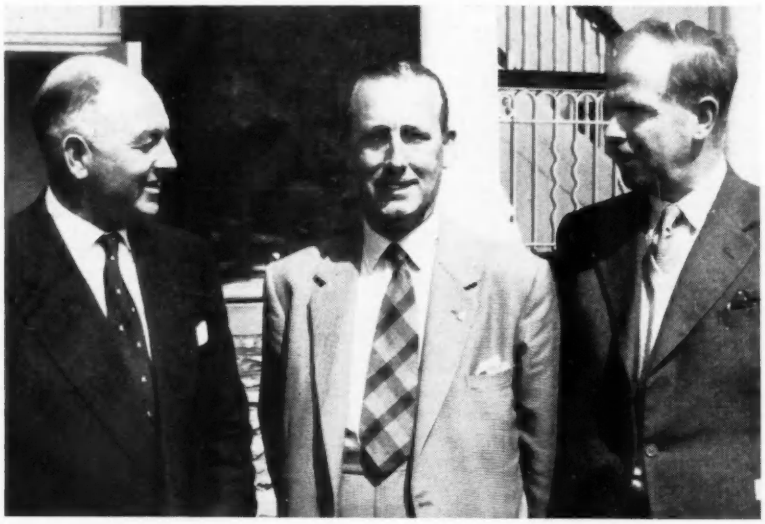
with this toast. I am a most fortunate man who has had the rewarding experience during the last twelve months of serving as President of this great Institution, where I have throughout experienced full support and good fellowship from everyone.'

The PRESIDENT next proposed the toast of the guests, with which he coupled the name of Sir William Jones, C.B.E., Deputy Chairman of Denbighshire Quarter Sessions, a member of the Wales Gas Board and a participant in much other public work; but before the reply Telynores (Harpist) Gwenllian Dwyryd was invited to convey welcome to the guests through the strings of the harp.

SIR WILLIAM JONES noted that the President had referred in particular to his master or ex-master or master of them all, Mr. Clarke Jackson. He, Sir William, often wondered whether in an earlier life Mr. Jackson had been commissioned by Noah to provide gas for the Ark.

Continuing, Sir William said they all knew of the great interest the President took in the industry, and his fondness of discussing gas on all possible occasions; how determined he was in his views when he had investigated any matter and had come to a conclusion. His answer to an examination question when he was quite a young pupil was indicative of his personality. The question put was, "How would you lay a pipeline across a lake and up a mountain?" The answer, which was typical, was: 'I would dam the lake and blast the mountain.' This secured for him the first step towards becoming a member of this very honourable Institution.

CAMERA AT THE MEETING



Jack Anstey (Parkinson Cowan Appliances) with A. Pickard (Swansea) and J. A. Derbyshire (Bangor, Co. Down).

Right: *S. M. Milbourne, Chairman of C. & W. Walker.*

N. J. Robertson (Dublin; Director, Irish Gas Association) with C. A. Macleod (R. & A. Main).

S. C. Thomson (Clayton's) and J. Grayston, G.M. (North Cheshire).

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L. Bain (Greenock), F. B. Oliver (Singapore), A. M. Jackson (Dumbarton) and T. R. Cameron (Coleraine).

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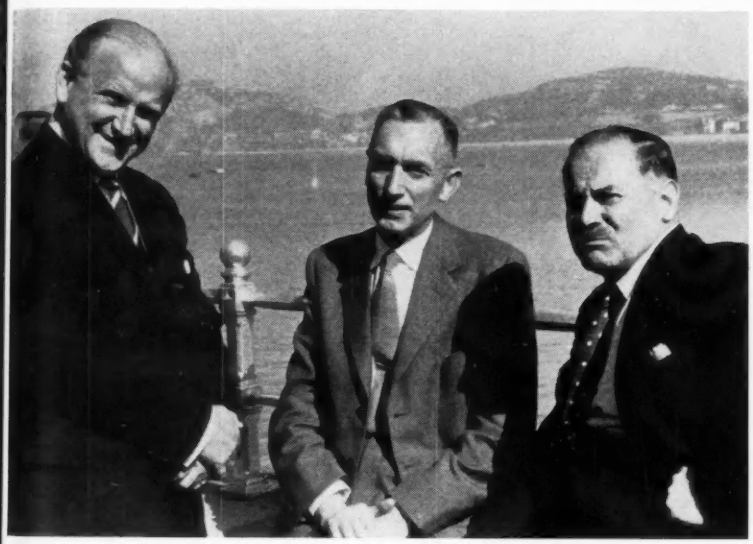

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H. E. Dyble, T. W. Clapham and A. F. Cottrell, of W.-D.

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T. L. Tallentire (Cheltenham) with E. Aspinall and B. C. Morton, both of Robert Dempster.

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D. S. Davies (Abertillery) with A. G. E. Sadler and W. Q. Foster (both Parkinson Cowan Appliances).

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Geo. Jeffs (Ascot), Chas. Josiffe (Bratt Colbran) and James Ward (East Lancashire).

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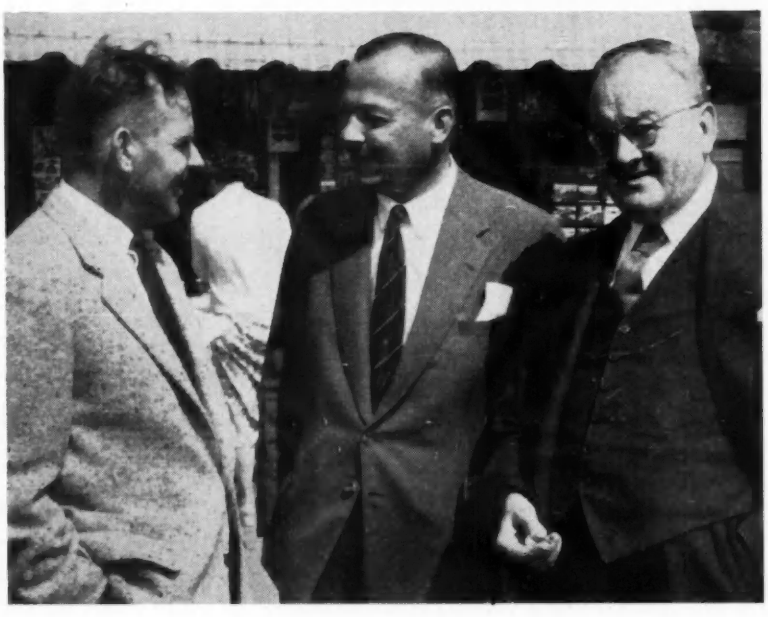

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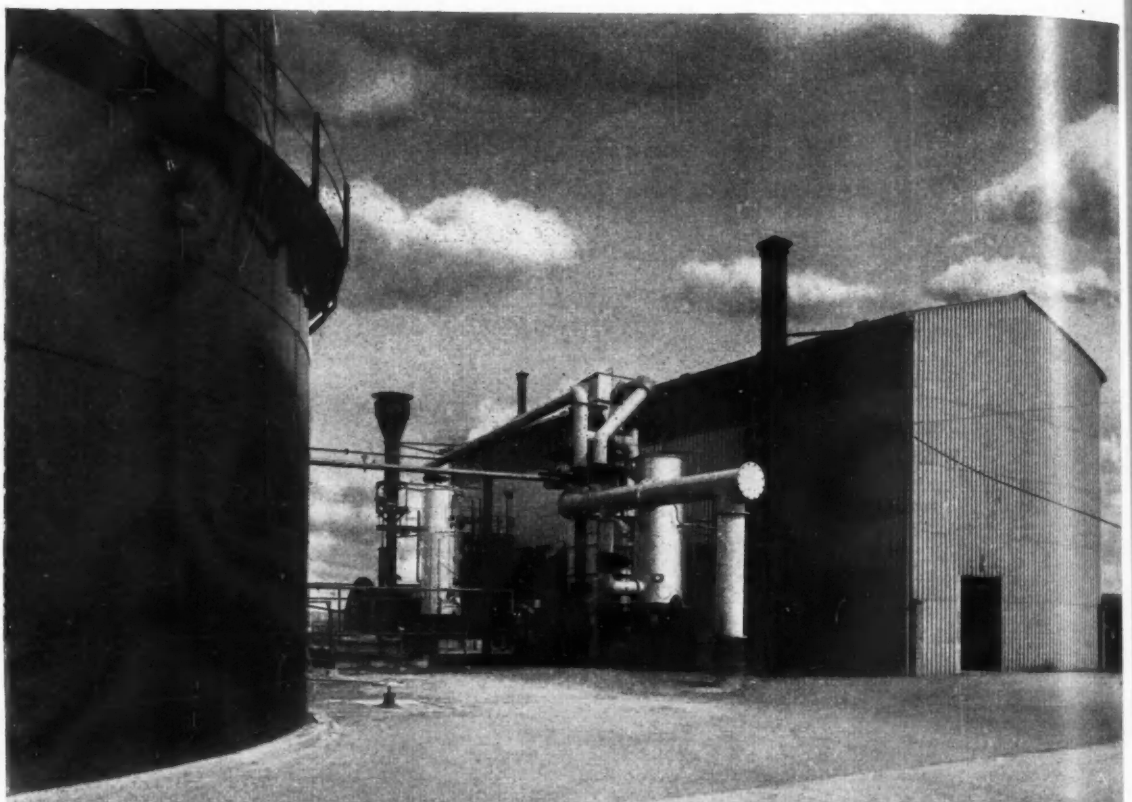
J. O'Regan (Waterford; President, Irish Association), Francis Drake (Drakes) and H. Dumbleton (Dublin).

★

Institution visits

E. Emrys Jones

In addition to an extensive whole-day tour of Snowdonia, which afforded views such as is seen in the picture above, and the ladies' coach excursions, there were at the 96th A.G.M. visits to the industrial plants and works described in this supplement.



The reforming plant house at Point of Ayr

Point of Ayr colliery and methane station

THE Point of Ayr pit is exceptionally 'gassy' as a result of the impermeable nature of the strata overlying the coal and the location of the workings under the tidal waters of the Dee estuary.

Methane under pressure has been encountered in the coal seams at Point of Ayr for more than 70 years and schemes for its utilisation were put forward in 1927 and again in 1939, although it was not until 1950 that methane supplies were made available for use in the colliery boilers.

In 1955 an additional outlet for methane was provided by the National Coal Board by the construction of a power house containing five 700-kW. English Electric alternators driven by 1,100 b.h.p. English Electric dual fuel engines operating on methane or fuel oil.

The methane is collected by drilling from the seam already being worked to the next important coal bearing layer which lies about 20 to 30 yards below, the bore holes being connected to a 10-in. diameter collecting main which finally delivers the methane to the Wiggins gasholder erected by the National Coal Board, which acts as storage for both the Coal Board and the Wales Gas Board.

At the present time, 90 bore holes are available for supplying methane out of a total of 140 drilled.

A 20-year contract has been made between the National Coal Board and the Wales Gas Board for the purpose of a joint experiment in the utilisation of methane from coal mines and provides for the supply of 4½ mill. cu.ft. per week of gas from the colliery, at a calorific value of 980 B.t.u. per cu.ft. and a pressure of not less than 6 p.s.i.g., the gas board being entitled to reject any gas which has a calorific value of less than 830 B.t.u. per cu.ft.

Provision is made for the release of quantities of gas additional to the contract quantity by the use of fuel oil instead of methane in the dual fuel engines operated by the National Coal Board for electricity generation.

The b.w.g. plant in the reforming plant house consists of a Humphreys & Glasgow blue water gas generator and superheater, complete with waste heat boiler and washer cooler. The plant boiler and washer cooler. The plant operated. Generator fuel is handled by an electric hoist and portable skip. The plant has a daily capacity of 0.95 mill. cu.ft. of blue water gas with a generator fuel consumption of about 16 tons of coke per day.

When used for cold enrichment of blue water blow gas by the contract quantity (0.6 mill. cu.ft. per day) of straight methane, this plant is expected to have a capacity of 1.75 mill. cu.ft. of 500 B.t.u. gas per day.

When used for thermal reforming of methane in the generator fuel bed, the plant is expected to have a capacity of 1.26 mill. cu.ft. of 500 B.t.u. gas per day with coke and methane consumptions of six tons and 0.6 mill. cu.ft. per day, respectively.

The Onia-Gegi plant, also housed in the reforming plant house, consists of a combustion chamber, catalyst vessel and mechanical operator inside the building, with waste heat boiler, wash box, washer cooler, and naphthalene washer outside the building.

Methane and air are burnt in the combustion chamber and the resultant hot 'blow' gases pass through the catalyst bed and waste heat boiler to the stack valve.

When the catalyst bed has been

Continued on p. 451

PRECISION NEEDS SMOKELESSNESS

Perfect conditions found for new lens making factory

THE benefits to be gained from the use of refined smokeless fuels were seen at the new Chance-Pilkington lens factory in North Wales which was brought into production in November, 1957.

At this factory, which has been built in the country about 1½ miles from the small cathedral city of St. Asaph in Flintshire, it was important that the activities of glass making should be carried on in a dust-free atmosphere under conditions of smokelessness.

For these conditions to be met, a site in the countryside away from the dusty smoke-laden atmosphere of South Lancashire, the traditional centre of glass-making, had to be found.

Guarantee needed

It was also necessary to have adequate fuel supplies to hand, and before any decision as to a suitable site could be made, a guaranteed supply of at least 5 mill. cu.ft. of gas per week was a necessity. An adequate supply of electrical power had also to be available.

The Board of Trade was approached and suggestions were made for sites on the North East coast, North Lancashire, Central Lancashire, Northern Ireland and the North Wales coast.

Other considerations which had to be taken into account were: At any given site land had to be available for future expansion; the district had to have the amenities to attract the necessary technologists and scientists; and labour had to be easily available in the district.

Since such conditions could be met at St. Asaph, and because it was within easy reach of Pilkington's main glass-making factory at St. Helens and good rail connections between North Wales, the Midlands and London, the site at St. Asaph was chosen.

The laying of the North Wales grid connecting the gas undertakings along the North Wales coast with the Maelor gasworks at Wrexham and the coke oven plant at Queensferry would assure an adequate supply of gas and supplies of electrical power could be made available in the district.

At this factory are manufactured optical and ophthalmic glasses. Their production demands a rigid control of temperature conditions both in the glass-melting tanks and in the channels through which the molten glass passes to the moulding machines. The moulding machines themselves must be kept at a high enough temperature to prevent a too-rapid cooling of the molten glass until it has entered the annealing lehr.

The glass-melting tanks which have been supplied by Corning Glass Inc., New York, are gas heated and thermostatically controlled. The molten glass of a viscosity depending on the temperature of the glass leaving the melting tanks, passes down a vertical electrically heated tube, the temperature of which must be controlled to within ±1°C. This ensures that the viscosity of the glass remains constant so that the weight of glass delivered to the moulding machine for pressing into an ophthalmic blank, or a 'gob' for optical blanks also remains absolutely constant.

The moulds are gas heated to prevent the molten glass becoming too viscous for pressing and, after pressing, cooling too rapidly before it enters the gas heated annealing lehr. As the blanks pass out of the lehr they are inspected. Any which show an obvious fault in the glass, such as entrapped air or discoloration, are immediately thrown out by the inspector but, since the dimensional tolerances must be maintained within very fine limits, sample blanks are taken every half-hour and tested in the laboratory.

Superlative quality

The weight of the 'gobs' is kept to about 40 grams, but the ophthalmic blanks which will be ground directly to spectacle lenses must have their periphery and thickness maintained to within .22 mm., equivalent to a weight of 1 gram of glass. To do this the tolerance of the moulds has to be kept within .001 in.

The output of blanks of both types amounts to 60 mill. a year. Since the factory came into production the optical glass made there has proved to be of superlative internal quality and colour.

One new Hotpoint washing machine every 90 seconds

THE Llandudno works of A.E.I.-Hotpoint Ltd., making the Countess and Princess washing machines, are an unmistakeable landmark for tourists in North Wales.

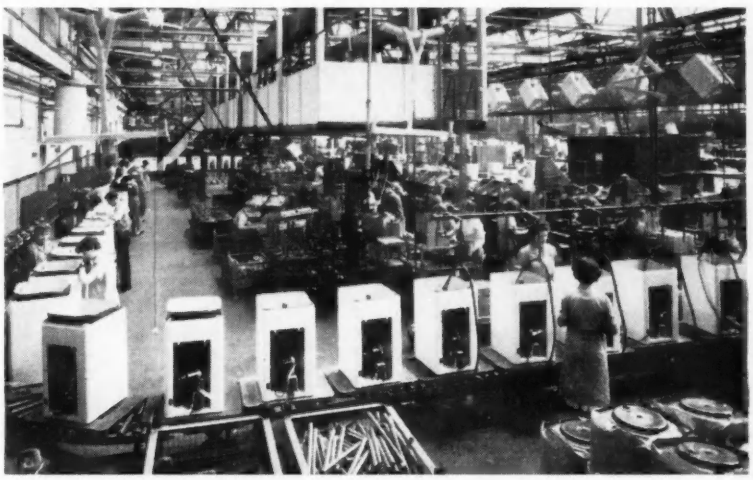
From the picturesque road along the Conway to the broad estuary, the long, compact, single-storey white building dominates the valley; below it runs the main Conway-Colwyn Bay and North Wales coastal road.

Unlike the main factory at Peterborough, where scattered buildings have been adapted to the manufacture of Empress washing machines and Pacemaker refrigerators, the Llandudno production flow is continuous, from raw material at one end of the factory to the finished washing machines, packed and loaded, at the other.

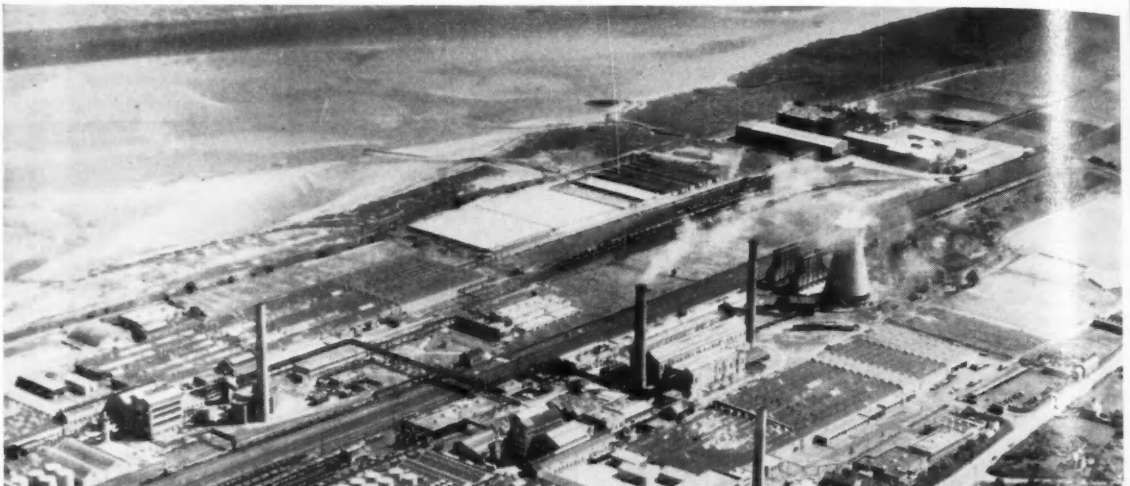
The impression everywhere is of compact planning yet of the most advanced tooling and specialised machines developed for multiple operations.

On one line are assembled the gear-boxes, which are electrically-driven by Hotpoint motors and which power the gyrator and, in the Countess, the wringer. On another, cabinets are formed from steel sheet, are braced, spot-welded, bonderised against rust and stove-enamelled in infra-red ovens.

Inspected and tested at every stage, the products of both lines then meet, the gear-box is installed, bowls, electrical details and exterior trim are added. There are more tests—electrical tests, tests for silent running—and another completed machine leaves the line. The rate of production is one machine every 90 seconds.



The assembly line at A.E.I.-Hotpoint Ltd., Llandudno.



Half the U.K. output of fibres and yarns

COURTAULDS' Greenfield Works, at Holywell, North Wales, produces nearly 200 mill. lb. of fibre a year. This represents nearly 50% of the total U.K. production of all man-made staple fibres and yarns, rayon and synthetic together; or 90% if staple fibres are taken alone. Rayon staple is used for every kind of textile from clothing to carpets.

The Greenfield factory lies astride the main London-Holyhead railway, and consists of two main production units. The factory generates its own primary and secondary services, the power house being fired by coal. Several million gallons of soft water are used daily in the fibre manufacturing processes.

The principal raw material is cellulose in the form of woodpulp imported as sheets from Scandinavia and South Africa. The main chemicals used in the process are caustic soda, carbon disulphide and sulphuric acid. The last two are supplied by the company's own chemicals division which, incidentally, operates two sulphuric acid plants on the Greenfield site. Coal, woodpulp and caustic soda arrive by rail. Road transport is used for the delivery of carbon disulphide, and for the despatch of finished fibres to the spinning mills of Lancashire and Yorkshire, for example, and to docks for export.

Approximately 2,400 people are employed at the factory. The production departments work continuously day and night on a three-shift system.

The factory operates the viscose process of rayon staple production. The broad principle of the process is the conversion of cellulose into a solution for reforming and regenerating into a filament. Bulk handling of very large weights of pulp and chemicals is required. Woodpulp is steeped in caustic soda to form alkali cellulose, the excess soda is pressed out and the sheets are ground into crumbs which are stored for a period to allow molecular change to take place. The alkali cellulose is then combined with carbon disulphide to form cellulose xanthate. This is dissolved in dilute caustic soda and the resultant viscous liquid is known as 'viscose.'

After filtering and 'ageing,' the viscose is extruded as filaments through the fine holes of a large multi-holed jet which is immersed in a coagulating bath containing sulphuric acid and minor proportions of other chemicals. The jet, which is made from a platinum/gold alloy, may contain as many as 10,000 holes. On contact with the acid liquor, the filaments coagulate, are drawn together and led out of the bath as 'tow' of about rope thickness. Each tow consists of as many as 350,000 individual continuous filaments. The tow is collected and passed into a cutter which cuts it into filaments of the desired staple length. The length of staple depends on the particular branch of the textile industry for which the fibre is required.

Alternatively, the tow is retained in continuous filament form for use by manufacturers operating new methods of converting tow directly into tops and yarns, which eliminates the need for conventional carding.

The cut fibres or continuous tow are finally washed free of excess chemicals, dried and baled for despatch. The 'regeneration' process being complete, the finished fibres consist of pure cellulose.

An increasing proportion of rayon staple is being produced in a range of so-called 'spun-dyed' colours. This is done by incorporating pigments into the viscose solution before it is extruded. Such fibres have an exceptionally high degree of colour fastness.

The commercial development of rayon staple began in the 1920's and much of the early pioneering work was done in a neighbouring factory of Courtaulds. By 1934, production on a very large scale became necessary and Greenfield Works was built. Output was then only about 20 mill. lb. per year. The use of rayon staple in spun rayon apparel and furnishing textiles has been an established trade for a great many years. More recently, and particularly since the second world war, its uses—either alone or in blend with almost any other natural or man-made fibre—have extended into nearly every kind of textile application.

Of particular note is the growing and substantial trade which has developed in tufted and conventionally woven carpets and in suitings and trouserings. Rayon staple is in fact acknowledged to be the most versatile of all textile fibres.

THE MANY USES OF GAS BY MONSANTO CHEMICALS LTD.

MEMBERS of the Institution of Gas Engineers visited the Ruabon, North Wales, factory of Monsanto Chemicals Ltd., which produces a range of over 200 products, including phenol, salicylic acid, phthalic anhydride, rubber chemicals, synthetic adhesives and chemicals for the textile industry.

The company has other factories at Newport, Monmouthshire, and Fawley, near Southampton.

Drying sulphite

Gas is used at Ruabon for heating high pressure reactors in the manufacture of certain rubber chemicals and also in supplying a portion of the heat required in the fusion stage in the manufacture of synthetic phenol. One of the biggest usages of gas is for the drying of by-product sodium sulphite arising from the manufacture of phenol.

During their visit, members saw the modern pilot plant and also visited a plant in which gas-heated autoclaves are installed.

Starting point

The plant in which phthalic anhydride is manufactured was also seen. Phthalic anhydride is an important chemical used in alkyd resins and as a starting point for various organic synthesis.

Other parts of the factory visited included the power house—one of the largest industrial power installations in North Wales—and the well-equipped engineering workshops.

A reaction unit in the pilot plant at the Ruabon, North Wales, factory of Monsanto Chemicals Ltd. The factory produces a range of over 200 products.

Pioneers in the aluminium industry

THE Aluminium Corporation Ltd., has been established for over 50 years, and is one of the pioneers of the aluminium industry, both in the production of the metal from its ores and its fabrication.

Force of circumstances prevented the company from continuing the production of aluminium beyond the end of the second world war, and supplies of virgin ingot metal are now derived from Canadian sources.

The company's activities are now concentrated entirely on the operation of its Dolgarrog rolling mills which have been recently extended.

The factory is engaged in the production of aluminium and certain aluminium alloys which are supplied in sheets and circle form and cover a range from 2 in. plate down to near foil at 0.006 in. thick.

Manufacture commences at Dolgarrog with the casting of 400 lb. rolling blocks into water-cooled chill moulds. These blocks are the raw material for the rolling mills where they are hot rolled on a modern two high reversing mill which converts them into 40-in. wide sheet stock at 2 in. thick, or tight rolled coils up to 30 in. wide and 2 in. thick for conveyance to the strip mill.

Sheet rolled products are finished over a wide range of sizes and guages. Circles are also produced from sheet rolled material for the holloware and kindred industries. Strip rolled metal is also produced in coil, strip and sheet as required by the consumers.

The factory aims at the production of high grade deep drawing quality sheets and circles of clean bright surfaces so important to the finishing industry. Production equipment, including annealing furnaces, heavy duty presses and levelling machines are all designed to this end, as is the training of personnel.

Point of Ayr

Continued from p. 448

raised to operating temperature the air is shut off and methane admitted with steam to the combustion chamber to be pre-heated before passing through the catalyst bed where the methane and steam interact to form carbon monoxide and hydrogen.

The capacity of the plant is estimated at 1 mill. cu.ft. per day of 500 B.t.u. gas when taking a total of 0.6 mill. cu.ft. of methane per day for reforming and enrichment, or 1.75 mill. cu.ft. per day of 500 B.t.u. gas when taking a total of 1 mill. cu.ft. of methane.

Compressor station on reclaimed land

MEMBERS of the Institution who visited the Wales Gas Board's compressor station at Shotton were told that the site consisted of land reclaimed from the River Dee. The site is leased from John Summers & Sons, Ltd., and covers an area of 5.8 acres.

The unpurified coke oven gas is pumped from the coke ovens through an overground 24-in. diameter steel main to the control governor at the inlet of the 16-in. by 48-in. Connersville meter, having a rated capacity of 6 mill. cu.ft. per day, and thence to the oxide purifiers and gasholder.

The purifiers, which are of orthodox design, consist of five boxes each 40 ft. by 40 ft. by 5 ft. deep, installed at ground level and contain a total of 750 tons of oxide. The inlet, outlet, and return mains are below ground level in a duct alongside the purifiers. Provision has been made for air for revivification *in situ* to be added to any of the five boxes. This plant has a nominal capacity of 4 mill. cu.ft. per day of coke oven gas.

A feature of the plant is the specially designed gantry for handling oxide skips for emptying and filling the boxes and providing weather protection for the men working on the oxide.

The compressor house consists of an aluminium sheeted steel-framed compressor room, recently extended, with switchgear room, pressurisation room, and attendant's cabin situated at one end.

The plant installed comprises four 2-crank, reciprocating, two-stage Belliss & Morcome gas compressors, three machines having been converted from single-stage and each driven by a 350 h.p. 7-cylinder dual-fuel engine operating on diesel oil or purified coke oven gas with oil ignition. Each compressor is rated at 85,000 cu.ft. per hour against 150 p.s.i.g. at 333 r.p.m.

Provision has been made for the accommodation of two further two-stage compressors in the extended portion of the house, one of which will be installed during the current year.

In addition, a booster is installed in the house. This machine is driven by a 45 h.p. electric motor situated in the switchgear room and has a capacity of 40,000 cu.ft. per hour against 5 p.s.i.g., and is used for supplying gas through a 10-in. diameter grid main to a portion of the Deeside section of the grid if required and also to John Summers, Ltd., for domestic purposes.

The pressurisation room houses Sturtevant air filters, gas-fired air heater, and electrically driven fan for maintaining a supply of warm, clean air into the compressor house.

Electricity is supplied to the station from John Summers, Ltd., via duplicate power cables at 2.2 kV. Two 250 kVa transformers reduce the supply to 415 volts A.C. The high and low tension switchgear and distribution panels are accommodated in a single storey building adjacent to the office block.

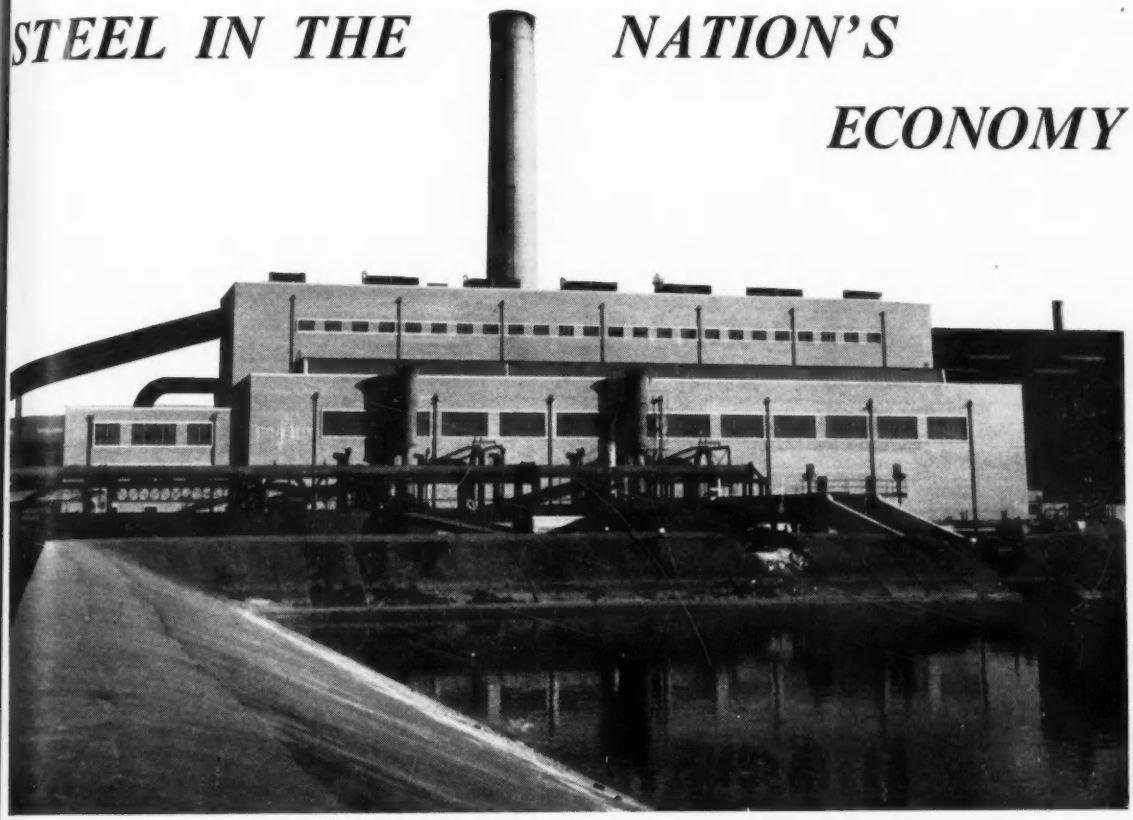
Inlet and outlet compressor manifolds, both 24-in. diameter, are situated parallel to the compressor house. Connected to the outlet manifold are two after-coolers which feed direct into the 14-in. diameter high pressure grid main, supplying the coastal section of the grid. All the gas valves on the compressors can be operated from inside or outside the house and complete isolation of the compressor house can be effected in emergency.

Cooling water for the compressor jackets, inter-coolers, and after-coolers is recirculated through Heenan & Froude forced draught cooling towers, which are installed in two sets of two with water pumps in triplicate.

The gasholder is of all welded construction having a capacity of 500,000 cu.ft. and consists of three spiral-guided lifts in a steel tank above ground.

In order to meet extreme peak load conditions on the North Wales grid, the installation of a 50-ton butane storage plant complete with vaporiser has been authorised. Erection is expected to be completed by the end of the calendar year. This plant will have a releasable capacity of approximately 1.5 mill. cu.ft. of town gas equivalent per day.

STEEL IN THE NATION'S ECONOMY



A view of the Hawarden Bridge steelworks, showing the power station.

A STEELWORKS is perhaps the most impressive heavy industry plant to be seen. Institution members were suitably appreciative when they visited the Hawarden Bridge steelworks of John Summers and Sons Ltd., which has been making steel for 56 years. Until only five years ago all the pig iron from which the steel was made had to be brought from elsewhere and this dependence on outside supplies would have seriously restricted the company's post-war plans for increasing its output of steel. So in 1948 work began on the first of the two blast furnaces which now supply the steelworks with all its iron. The same plan provided for the construction of four batteries of coke ovens to supply the blast furnaces with all the coke they need. The first blast furnace was completed in 1953; the whole installation in 1955.

The focal point of a steelworks is its melting shop. For it is here that the steel is actually made, and upon the capacity of its furnaces depends the output of the whole works. It was a natural decision, therefore, that a major feature of John Summers' post-war development plan should be the construction of an entirely new and much larger melting shop. Work began in 1947 and the new steelworks with its eight open-hearth furnaces came into service five years later. Now further extensions have been built and four new furnaces added. Soon, it is confidently expected, production will rise to 1.9 mill. ingot tons a year, or more than four times what it was when the second world war came to an end.

When the steel leaves the melting shop it is allowed to solidify in ingot form. These steel ingots then go through a series of rolling mills, first the slab mill, then the hot strip mill and finally the cold mills and finishing departments from which they emerge as thin steel sheet ready to become part of a car body or a refrigerator. The last ten years have seen many important developments in John Summers' rolling mills ; new and more powerful motors have been installed, the capacity of the cold mills increased, all with the same aim of raising the output of finished steel sheet and enabling the company to play its full part in the national plan for expanding the output of steel.

Until about 1930, the company's trade was chiefly in galvanised steel sheets for export. The tide eventually turned in favour of steel sheets as a material for the manufacture of a host of new appliances used in daily life.

The home was one field for new devices. Secretaries tapped typewriters. Shop assistants counted their change out of cash-registers. The builder began to use steel doors, window frames and partitions. The railways built steel railway coaches, the shipyards divided their ships internally with steel panelling. Everyone wanted sheet steel, and wanted new varieties of it.

To meet this new demand, the company decided in 1937 to install continuous strip mills, producing sheet steel of high quality and accurate gauge, that could be pressed or formed into the many shapes necessary in the manufacture of modern appliances ; tough yet pliable enough to be drawn into the shape of a motor-car wing, or a refrigerator door. The trade in galvanised sheet lessened as foreign countries began to make their own. Once the war was over, and the strip mills were able to turn from war production, the company became primarily a supplier for the home market. The direct export of steel remains a most important part of its trade, but its largest contribution to the export trade is made through the many home industries which it supplies with steel sheet.

John Summers at present exports steel sheet to nearly 50 countries; including to all parts of the Commonwealth and to Europe. But so heavy is the demand for steel sheet by industry at home that exports have to be limited by licence.

Twenty-five years ago 80% of the annual production was exported. Now more than 80% is sold at home. But although the amount of steel directly exported is still quite large, the company's chief contribution to the nation's export drive today is through finished products shipped abroad by other manufacturers.

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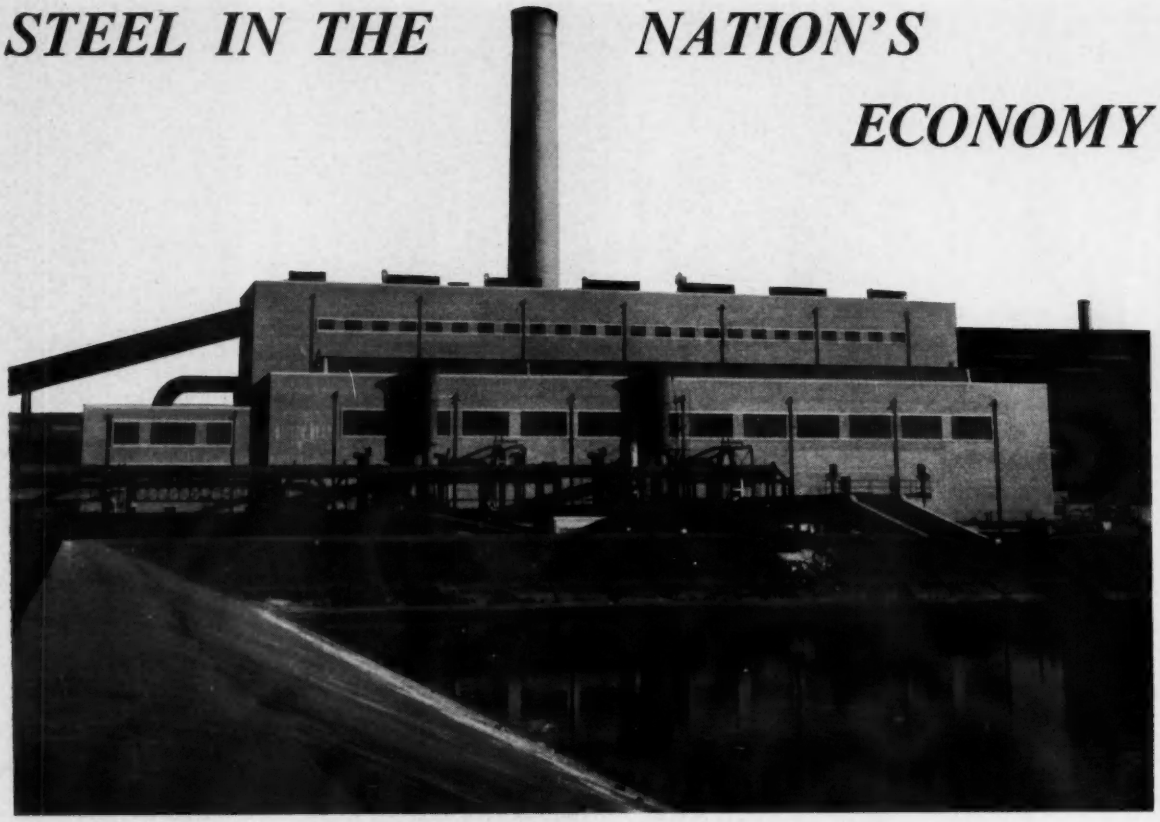

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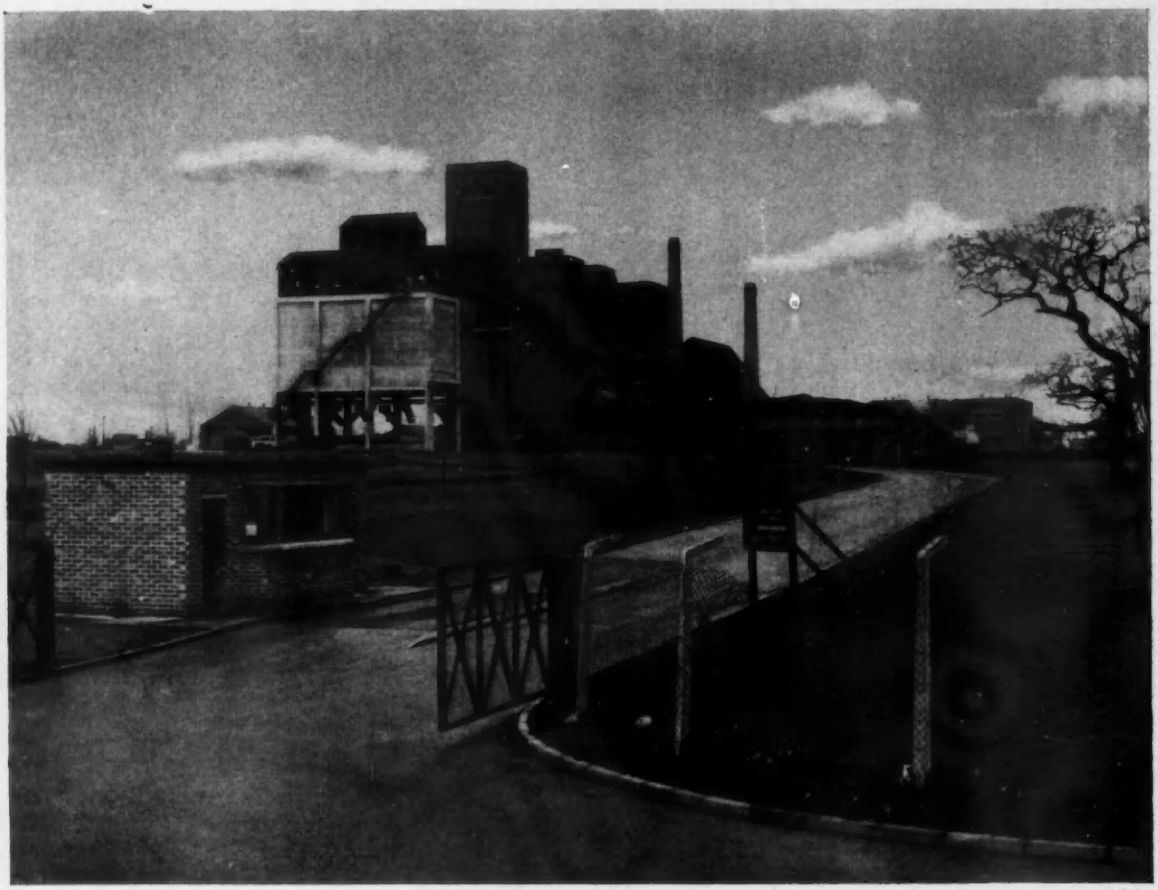


Maelor gasworks uses wide range of coals

GAS was first introduced in Wrexham in 1827 by Keay, Edwards & Company. Twelve years later, the Wrexham Gas & Coke Company was formed and a new works erected. Again, in 1869, a larger site became necessary and during the next three years the whole of the works was transferred to a new site. At this time the company, by Act of Parliament, became the Wrexham Gaslight Company, the manufacturing plant consisting of 56 hand-charged horizontal retorts. A second Act changed the name to the Wrexham Gas Company.

By 1938 the make of gas had increased from the 1900 figure of 100 mill. cu.ft. per annum to 223 mill. cu.ft.

Because of increasing demands for gas supplies, a modern intermittent vertical chamber oven plant of 25 chambers, with a capacity of 2.25 mill. cu.ft. per day was constructed. This was the position on vesting day.

In 1949 the Wales Gas Board acquired a site on the Wrexham Trading Estate and erected the Maelor works. Gas making commenced in September, 1953.

During the year ended March last, the total output at the Maelor works was 4,861,000 therms. The area of supply of the Wrexham undertaking only covers 38 sq. miles and 114 miles of mains serve 16,000 consumers.

At the works, intermittent chambers are not limited to selected high-grade coals but will deal adequately with a wide range, and particularly those of lower coking value, at the same time producing good yields of gas with a high degree of flexibility of output and in particular a strong coke of low breeze content suitable for both domestic and industrial use.

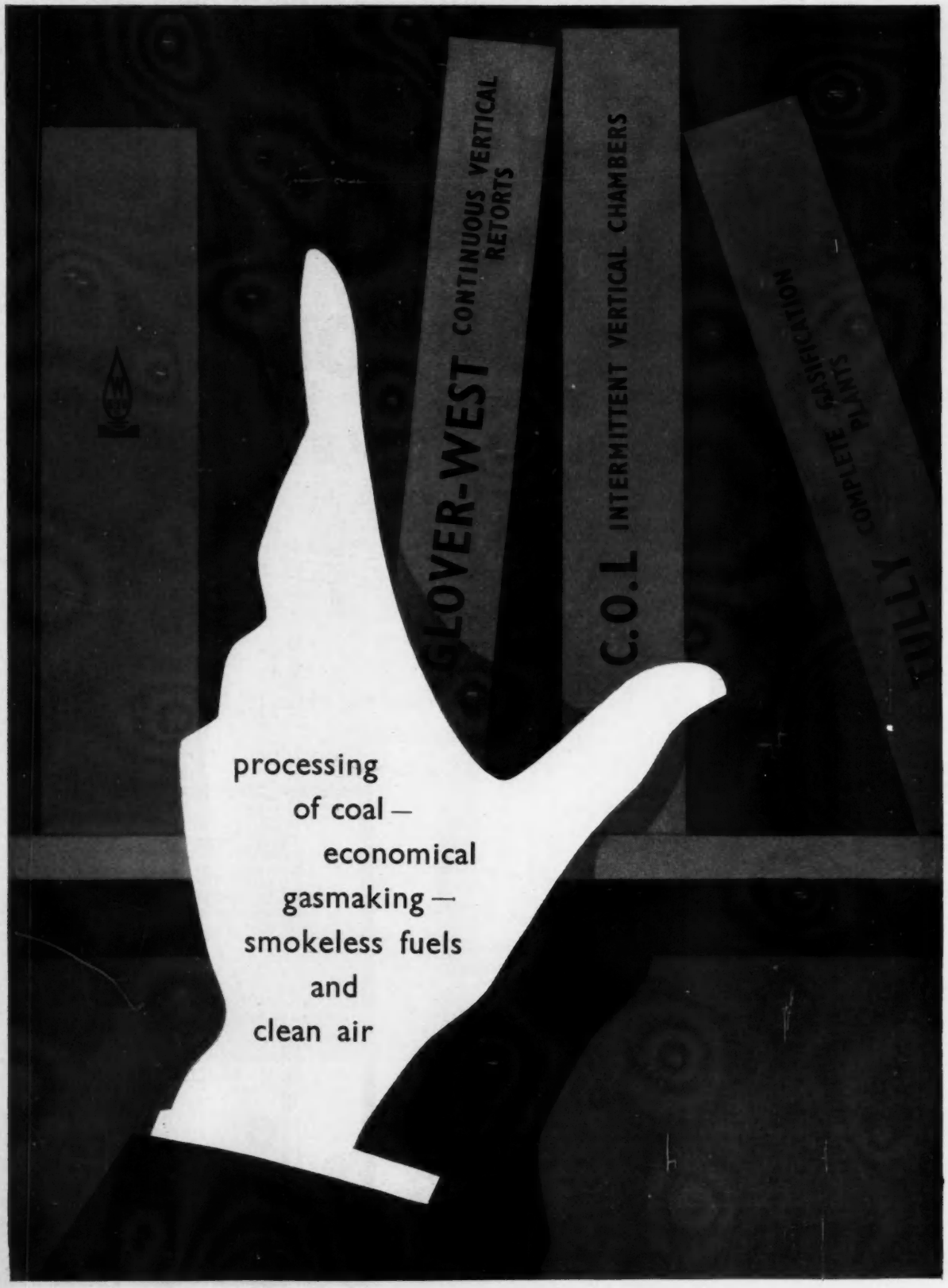
The carbonising plant, complete with the necessary coal and coke handling equipment, and coke grading, storage, and loading plant has been designed and built by W. J. Jenkins & Co., Ltd., of Retford, Notts.

The new installation consists of 25 chambers each of 3.65 tons capacity, arranged in one bench of five equal settings, and has a nominal maximum output of 2.25 mill. cu.ft. per day. It is housed in a modern, steel-framed building designed for extension to double the present size.

The chambers are constructed of 95% silica and measure approximately 19 ft. 2 in. high by 9 ft. 10 in. wide and are tapered 10¼ in. to 13 in. on the minor axis. The chamber heating flues are formed by continuous tongued and grooved key tiles bonding adjacent chambers throughout the full width, thus forming an entirely monolithic structure which gives maximum strength in the oven walls to withstand the pressures exerted by strongly swelling coals.

Expansion of the silica materials is provided for on the periphery of the silica work and this avoids the possibility of distortion thereby ensuring a long working life. The producer fittings are of the loose type to allow for expansion and to permit easy renewal. The recuperators are of the contra-flow type and a feature of this design, which gives absolute and easy control of temperature, is that each secondary air flue is entirely independent from the inlet slide to the combustion chamber. The settings are adequately insulated on bench top and side walls. The present carbonising routine of ten to 12 hour charges ensures the maximum throughput of coal per day.

The gas offtakes, hydraulic mains, valves, and collecting mains are continuously sprayed with hot ammoniacal liquor. Liquor is circulated by one of two pumps, one centrifugal type electrically-driven, the other a reciprocating type, steam-driven, which acts as standby.



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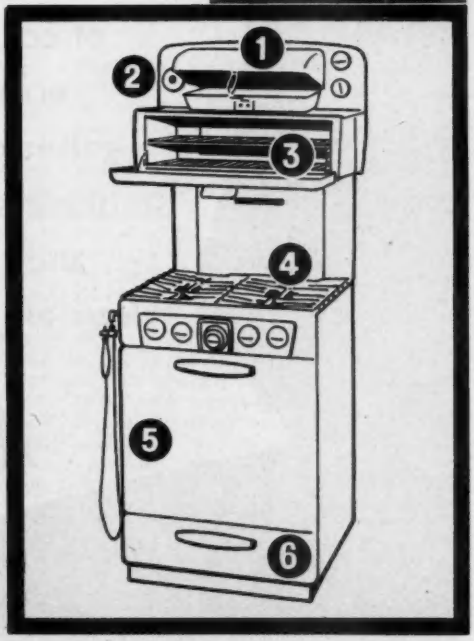

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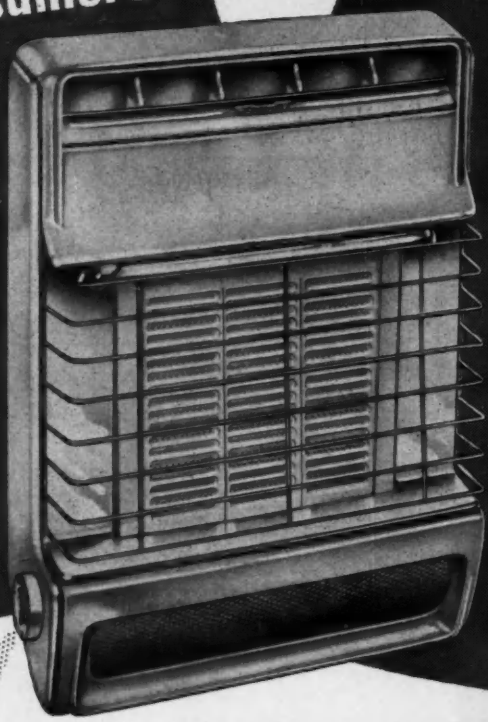

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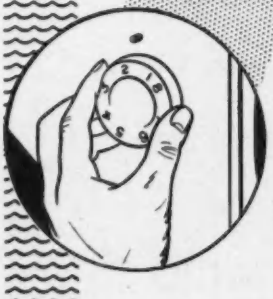

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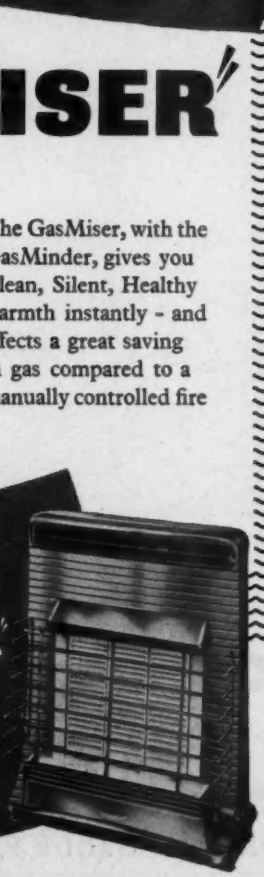

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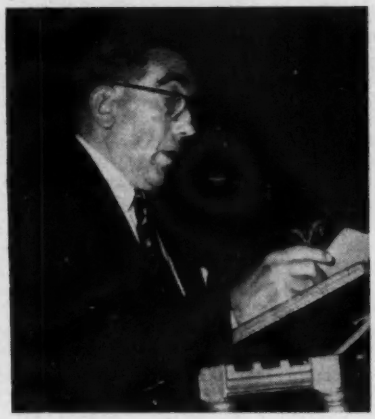

'GAS JOURNAL' abstract

Communication No. 544

Reorganisation of the Hong Kong & China Gas Co. Ltd.

By T. SPIKINS

B.Sc., M.Inst.Gas E.,

MANAGER, THE HONG KONG & CHINA GAS CO. LTD.

THE urban areas of the island of Hong Kong are divided from those of the mainland, Kowloon, by the harbour, a little over ¼ mile wide at its narrowest part and a very busy waterway. On January 1, 1955, control of the Hong Kong and China Gas Company, passed into the hands of the Wheelock Marden interests in Hong Kong though the company is still registered in the U.K. The reorganisation of the undertaking from that date is the main subject of the paper.

Waterfront site

The works at West Point in the island came into operation in 1864 but it was not until the 1890's that gas supply was initiated in Kowloon with the works at Jordan Road. In 1935 expansion in Kowloon led to the acquisition of a waterfront site at Ma Tau Kok where a gasholder of 500,000 cu.ft. capacity was erected. Before the end of the war both works had to be shut down for lack of coal but they were soon back at work with rapid expansion of output, until 1951 when it slowed down. Meantime, the population increased from about 600,000 in 1945 to something over 2,700,000 at the present time. Most of the increase was of very poor people, but some of the 'refugees' were experienced industrialists who set up factories and mills. Vertical retorts were installed at Ma Tau Kok, starting up in 1956.

The position at January 1955 was that both the existing works were old and out-of-date—Ma Tau Kok was under construction. The distribution system was becoming incapable of giving satisfactory pressures; suburban and industrial areas had built up outside the area of supply. Annual demand was actually falling but the company was financially sound. It was decided that control from London should be superseded by authority on the spot and the new Board now sits in Hong Kong under the chairmanship of Mr. C. E. Marsden, M.C.

At Ma Tau Kok the main gas making plant is a bench 16—40 in. by 46 in. Glover-west vertical retorts with a maximum realised output of 1.73 mill. cu. ft. per day using Chinese coal. There is one 58,000 cu. ft. per day Humphreys and Glasgow mechanically operated c.w.g. plant with space for a second one to be transferred from West Point. There is also a small hand-operated one built up from two old units from the Jordan Road works, giving a final nominal c.w.g. capacity of about 1.4 mill. cu. ft. per day. There is also space to add another eight retorts to the c.v.r. bench so that the final developed capacity of the works could be about 3.8 mill. cu. ft. per day. With the type of coke produced, however, the nominal c.w.g. figures will not be reached but it is anticipated that the fully developed output of the works should be at least 3.25 mill. cu. ft. per day.

Coal is brought in by lighter (at all states of the tide) to the concrete wharf and jetty, hand-stacked by coolie labour. Steam is generated by waste-heat boiler in the retort house, with solid fuel boilers as standby. Water shortage is a serious problem, being of the order of ten hours supply per day. A large underground water tank is therefore provided, augmented by a supply of brackish water from wells for flushing purposes. A Visco water-cooling tower is provided to conserve condenser water and that of other cooling plant. Ammoniacal liquor goes into the harbour. There are several compressors to ensure supply of gas in Kowloon and a further compressor, Bryan-Donkin 200,000 cu. ft. per hour. diesel driven machine at 25 lb. per. sq. in. is on order for supply to the island. A new holder, 450,000 cu. ft. capacity is erected on the other side of the road. The plant is complete with full instrumentation, laboratory and calorimeter room, together with mess room and other amenities for workers, and a clinic which serves their wives and children as well.

The plan of development was influenced very largely by the difficulty of acquiring suitable land, particularly in the island, where level sites are scarce. West Point works is over 92 years old. Necessary reconstruction was practically impossible. The Glover-West verticals were built in 1914 and the site was too small for sufficient expansion. Residential multi-storey development had made the site unsuitable for gas works purposes. It was therefore decided to centralise production at Ma Tau Kok. This necessitated the cross-harbour underwater gas mains.

Wales adviser

The cross-harbour underwater gas mains were entrusted to Land and Marine Contractors Ltd., after they had investigated the project and submitted a report. The undertaking was advised by Mr. W. T. Hird, Chief Distribution Engineer of the Wales Gas Board, who visited the site with the Chief Engineer of the contractors—a 'generous and practical example of co-operation and collaboration within the gas industry' for which the company acknowledges a debt of gratitude to the Wales Gas Board.

It was decided that if the mains could be laid quickly it would be safe to excavate a trench in the sea bed and fill in before silting took place. It was deemed that 5 to 6 ft. cover would give ample protection against possible damage from the dragging of anchors. The length of

96th A.G.M.

the crossing was about 4,850 ft. and the contour of the bottom of the trench while following that of the sea-bed was such as to leave only one low point 80 ft. below sea level to collect condensates.

Circumstances permitted the very early delivery of 10-in. Polish steel pipe which was first shipped to England and wrapped with $\frac{7}{16}$ in. of Wailes Dove tar enamel reinforced with fibreglass and then sent East. Lengths of main were prepared on the Kowloon side. Joints were welded and further covering was put on consisting of weldmesh reinforcing steel with a 1-in. coating of Gunite. The weight of the pipeline in water was some 20 lb. per ft. run. This was reduced to 7 lb. per ft. run by buoyancy tanks at 250 ft. intervals. Launching was by a $1\frac{1}{4}$ in. diameter steel wire-rope laid in the trench and hauled in by a winch on the island side. Details of the laying, testing and the siphon arrangements for the removal of condensates are given at considerable length in the paper. The whole operation took about eight hours.

Turning to a description of the new plant installed at Ma Tau Kok, on the other side of the road from the original works, the author sets out the reasons for the adoption of catalytic oil-gas plant. Apart from the poor quality of coke for water-gas manufacture and the limited market for coke in a warm climate, there was no question of indigenous supplies of fuel—all fuel, whether coal or oil, must be imported. And it was estimated that the cost of oil-gas would be competitive with the overall cost of coal gas and carburetted water gas as now practised. 'The characteristics of such oil-gas would, of course, be very similar to the gas now produced in the colony.'

Two 750,000 cu.ft./per day Segas catalytic oil-gas units are now in course of construction. These will make good, with some margin, the capacity lost when West Point closes down. They are arranged so that a further two 1.5 mill. cu.ft. per day units can be installed at a future day bringing the ultimate nominal capacity of the works up to 4.5 mill. cu.ft. per day.

It was deemed that oxide purification was still the most suitable process for Hong Kong. Space demanded that the boxes should be elevated with room for oxide underneath and an overhead oxide floor which would serve to keep the sun off the boxes during the summer. Reinforced concrete was estimated to be competitive with cast iron or steel. Designs were by Peter Lind & Co. Ltd., but construction by local contractors.

Oil storage tanks, three in number, will be enclosed within a reinforced concrete wall high enough to hold the oil from all the tanks in case of damage. The plants are designed for hydraulic operation. Details of ancillary plant are given in the paper.

By 1960, with West Point closed down, it is estimated that plant capacity of 4,400,000 cu.ft. per day will be available to meet a maximum demand of 2,570,000 cu.ft. per day, and that by 1965 plant capacity will be 5,250,000 cu.ft. per day (though this may be less because of lack of coke for c.w.g.) against a maximum demand of 3,230,000 cu.ft. per day.

Although Hong Kong has a population of nearly 3 mill., living standards are so low that only a small percentage can be considered as potential consumers. The cost of distribution in capital charges alone is relatively high. The terrain is difficult, particularly on the island; trenches have frequently to be blasted out of solid rock, up the hillside at an angle of 45°; there is a very low consumer load per mile of main—11,500 meters in 192 miles, 60 consumers per mile. Water-heating accounts for a high proportion of gas demand, mostly multi-point units with high gas consumption rates, posing serious peak-load problems when coupled with restricted periods of water supply.

Kerosine and fuel oil are the most serious competitors. Gas is reasonably competitive with electricity for water-heating and Chinese cooks prefer gas with its visible flame. Liquefied petroleum and bottled gas present no immediate problem, but consideration is being given to the possibilities of butane/air installations in satellite communities.

The price of gas in the Colony (equivalent to 3s. 9d. per therm) though high by United Kingdom standards, has remained unchanged for several years despite rising labour and material costs.

'GAS JOURNAL' abstract—Communication No. 551

OPERATION OF LIQUID AND GASTECHNIK PURIFICATION PLANTS AT CARDIFF

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THIS paper gives details of two new types of gas-purification plants, to meet the particular requirements at the Cardiff undertaking of the Wales Gas Board.

A full description of each plant is given with details of operation, costs and information from plant experience. Part 1 deals with a liquid plant and its development to ensure complete reliability of H_2S removal, to statutory requirements, operating direct into holders. Part 2 not only deals with a Gastechnik tower installation operating very successfully with the removal of H_2S to statutory requirements, but, also, a new method of recovering high quality elemental sulphur, and an oxide pellet-making plant of original design, are described.

The total oxide box purifying capacity at the Cardiff works of the Wales Gas Board in 1953 amounted to less than 9 mill. cu.ft. per day. The rapidly increasing demands for gas, coupled with additional availability of crude coke oven gas, necessitated careful investigation of the special purification problems involved at a works supplying not only the demands of consumers in the Cardiff area, but also operating as a balancing and peak-load station feeding into the South Wales gas grid.

Availability

The planned availability of gas by 1958 was:

	Mill. cu.ft. per day
Crude coke oven gas ...	12
Carburetted water gas ...	6
Propane/Butane (diluted) ...	3
Total gas available ...	21

To cope with the additional gas load it was decided to install two more purification plants, each of a new type:

(a) A 6 mill. cu.ft. per day liquid purification plant of the Manchester type, to meet emergency and peak load demands mainly operating on carburetted water gas.

(b) A Gastechnik dynamic oxide purification plant of a nominal capacity of 8 mill. cu.ft. per day, but capable of overload up to 12 mill. cu.ft. per day, operating mainly on coke-oven gas.

Both plants were designed to remove H_2S to a concentration lower than the legal limit for town gas, and sulphur recovery was incorporated in both systems. In the Manchester plant, sulphur cake containing 40-45% sulphur was obtainable, while in the Gastechnik plant, high grade sulphur (98% S) was recovered. The policy of installing sulphur removal

plant was decided upon as the result of a commercial assessment, undertaken in 1955, which revealed the possibility of spent oxide becoming increasingly unattractive to manufacturers, as a source of sulphur, compared with other sources producing a very highly refined product.

Manchester Liquid Purification Plant.—In this process the crude gas is washed with a weak alkaline solution containing a fine suspension of hydrated ferric oxide, the hydrogen sulphide in the gas reacting with the weak alkali to form soluble alkaline sulphides. These soluble sulphides react slowly with the iron hydroxide suspension, in a separate delay vessel, forming mainly iron sulphide with a regeneration of alkali. This solution is then oxidised in a third vessel, and the iron sulphide is regenerated to iron hydroxide with the liberation of sulphur.

Six washing towers have been found necessary to reduce the H_2S content to below the statutory limit.

The plant comprises: (i) gas scrubbers, (ii) delay, or reaction vessels, (iii) oxidisers, (iv) sulphur recovery plant, (v) reagent mixing plant. The gas scrubbers are six mild steel towers, 6 ft. diameter by 23 ft. overall height. Gas passes through these in series. Washing liquor flow is divided into two separate circuits, the first passing through the first four towers and the second through the two final towers. Attempts to use only one liquor circuit resulted in inability to remove the last traces of H_2S from the gas.

The delay or reaction tanks receive the spent liquor from the scrubbers, containing the H_2S products from the gas. These tanks are two in number, each 9 ft. diameter by 28 ft. high, with closed tops and conical base offtakes for liquor discharge. Time is allowed for the complete reaction of the soluble sulphides with the iron hydroxide in suspension, this period of delay being approximately 7 minutes. The liquor then overflows to the reacted liquor pump and is delivered under pressure to the oxidisers.

There are four oxidisers, each 14 ft. in diameter by 12 ft. 6 in. high, and these operate in parallel. These vessels have closed tops and are fitted with the necessary liquor offtakes, froth offtakes and automatic centrifugal defrothers. Air for oxidation is mixed with the liquor by means of 13 specially designed liquor-operated air injectors for each oxidiser vessel.

Alternative treatments

The liberated sulphur rises to the top of the defrothers and the sulphur sludge passes to a storage tank where further separation takes place. The separated liquor is returned to the circulating liquor and the sludge, containing approximately 6% of sulphur and 1.5% of ferric oxide, is pumped to a sludge boiler and there boiled by a Tricone steam heater, to coagulate the very fine sulphur particles. This operation can be carried out either as a batch process or treated continuously to equal the rate of filtration.

The coagulated sulphur sludge is gravity-fed to the filter bath of a Davy Paxman vacuum drum filter, fitted with a stainless steel gauze and nylon filter cloth. The sulphur cake as removed from the revolving filter drum contains 40 to 45% of sulphur, 35 to 40% of water, with 15 to 20% of iron and other impurities.

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Advantages of the process include:—

(a) Relatively small capital cost and reasonably low costs of purification. The plant cost £54,000 compared with £93,000 for oxide boxes of the same capacity. The capital charges are 0.07d. and 0.12d. per therm respectively. Purification costs vary greatly with the load in the plant. On full load, total net costs, allowing credit for recovered sulphur, amounted to 0.39d. per therm.

(b) Small ground space required (930 sq. ft. per mill. cu.ft.).

(c) Flexibility. This is of great importance when making peak-load carburetted water gas. After standing idle for long periods, the plant can be brought into operation to deal with the full purifying load well within the time required to raise heats on the water gas plants.

(d) Labour requirements of one man/shift obviates the necessity of having on call a relatively large body of men available for intermittent work.

The plant has comparatively high running costs compared with conventional oxide purifiers, i.e., electricity for prime movers. When purifying carburetted water gas, the temperature of the gas must be held below 70°F.; higher temperatures adversely affect the degree of hydrogen sulphide removal, due to light paraffin oils slipping through the electrostatic detarrer inhibiting oxidation of the suspended iron sulphides and causing excessive frothing of the liquor.

Gastechnik Process.—The essential difference between this type of plant and conventional static oxide boxes or towers is that the purifying material, which is in the form of semi-spherical cylindrical pellets, approximately ¼ in. diameter, flows through the purifying towers by gravity, being intermittently charged and discharged through gas-lock hoppers located at the top and bottom of each tower, without interrupting the gas flow. Continuous revivification *in situ* takes place in the towers by the action of a controlled proportion of air introduced into the gas. Sulphur recovery from the fouled and revivified oxide is carried out by a simple solvent process.

The main sections of the plant are:

(1) Purifying towers, with associated pellet-handling equipment.

(2) Pellet-screening plant.

(3) Sulphur extraction plant.

(4) Pellet-making plant.

The Cardiff plant contains a battery of 12 mild steel towers 9 ft. 6 in. diameter by 40 ft. high, arranged in four sets in parallel. The towers are plain cylinders with conical bases reducing to 8 in. diameter with a quick-closing sealing value to the bottom gas-lock discharge hopper of 50 cu.ft. capacity. Gas passes in series through each set of three towers. In the first two towers of a series, the gas enters at the top and leaves at the bottom, *i.e.*, concurrently with the direction of flow of the oxide pellets. In the third tower, which acts as a 'catch' for removing the last traces of H_2S, the gas enters at the bottom, and leaves at the top, *i.e.*, counter to the oxide flow.

This arrangement enables internal oxidation of the pellets and prevention of overheating to be achieved by measured air injection, through orifices on the air lines feeding into the inlet gas streams of the first two towers. To obtain optimum results, maximum (30%) sulphur loading of the pellets must be achieved.

In normal operation, only new pellets are added to the last tower (No. 3) in each set, and a mixture of new and extracted pellets is added to No. 1 and 2 towers. To the first, second and third towers, new and extracted pellets are added in an approximate ratio of 3:2:1 respectively. Pellets removed from No. 3 tower are normally returned to No. 2 tower, although, in certain circumstances, they are fed direct into No. 1 tower. Pellets from No. 2 tower are charged into No. 1 tower.

No difficulties

No difficulties have been experienced when operating the plant on overload. The back pressure is normally 6 in. w.g. and rises to 10 in. when passing 4 mill. cu.ft. set per day. Any one or more sets can be independently operated on overload. When operating on overload conditions, the pellet movement is increased, and this, in turn, results in a lower sulphur content in the pellets and loss in operating efficiency.

It has been found that the sulphur content of a fully oxidised pellet cannot be increased beyond 30%. At this point, the pores of the pellet become filled with sulphur and inhibit further reaction; also, the moisture content must be kept below 12%, as above this figure water progressively blocks the pores and confines reaction to the pellet surface.

OPERATIONAL RESULTS

	H_2S (gr. per 100 cu.ft.)	Sulphur in pellets (per cent.)
Inlet gas	350	
Outlet No. 1 tower	100	30
„ No. 2 „	Trace to 10	20
„ No. 3 „	0.01 p.p.m.	5

This comparatively low sulphur loading has impeded the more extensive use of pelletted materials. To improve the economics of the process, it is necessary to extract the sulphur to allow the pellets to be recycled. To obtain smooth pellet flow through the towers and maintain their maximum reactivity, it is essential that the pellets should be adequately screened at each stage of transfer move-

Continued on p. 465.

'GAS JOURNAL' abstract

Communication No. 547

Sources of grid gas supply in Wales

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AT vesting day, 93 undertakings in Wales were making gas, producing 40 mill. therms per year. But the purchase of coke oven gas for town supply was firmly established in South Wales, meeting 47% of the Board's total requirements. By December 31, 1958, the number of undertakings operating gas-making plant all the year round had been reduced to 29. In the year ended March 31, 1958, manufactured gas by all producing undertakings amounted to 16.6 mill. therms, 16% of the Board's total requirements, the remainder being bought from coke ovens (80.96%), coal mines and oil refineries.

South Wales. — The proposals, described in a paper presented to the Institution in 1952, were based upon the new 3.8 mill. cu.ft. per day c.v.r. plant, brought into commission in 1949 at Pontypool, a new coke oven plant under construction for the N.C.B. at Nantgarw and plans for further coke ovens to be erected at Cwm. As the load increased the Pontypool capacity was to be doubled, and at a later stage Cardiff gasworks was to be reconstructed as a base-load station.

Alternative provision

The Nantgarw ovens came into operation in 1951 with alternative provision of producer gas underfiring. The basic gas availability for these ovens, using rich gas underfiring, is 9 mill. cu.ft. per day purified and compressed into the grid. This can be increased in stages to 10.5 and 12 mill. by bringing one or two producers into commission.

The Cwm coke ovens were completed in 1958 with a basic gas availability of 8.5 mill. cu.ft. per day, purified and compressed into the grid, but here producer gas underfiring has not yet been installed.

Additional supplies of gas have been made available by the N.C.B. from its 'Phurnacite' low-temperature carbonising plant near Aberdare, to the extent of 1 mill. cu.ft. per day.

In 1956-57 arrangements were made with the Guest Keen Iron & Steel Company, Cardiff, to increase their supplies of crude coke oven gas from their East Moors ovens for purification at the Grangetown gasworks, Cardiff, from 8 to 12 mill. cu.ft. per day. Liquified petroleum gas storage capacity of 100 tons capacity have been installed at Cardiff to provide 2 mill. cu.ft. per day of diluted petroleum gas for intermittent use before water gas plants are brought on to regular load and for peak load purposes when all water gas plants are in operation.

Pontypool gasworks is the only station connected to the Eastern Section of the South Wales grid which is operated throughout the year. The new works was built in 1949 with a continuous vertical retort house with a daily gas-making capacity of 3.8 mill. cu.ft. at a calorific value of 475 B.t.u. per cu.ft. Experimental trials in accelerated carbonisation with producer gas as the carrier gas have led to the installation of liquefied petroleum gas storage of 33 tons capacity, initially for the straight enrichment of producer gas or of diluted gases produced by accelerated carbonisation.

Basic and maximum availability of gas in the Eastern Section are tabulated under the several headings together with actual and estimated requirements under present conditions and as estimated (up to 1970) when the grid was designed.

South Wales, Central and Western Sections.—The proposals, described in the 1952 paper, for linking together 13 undertakings in the Port Talbot and Swansea areas were based on an existing 6.75 mill. cu.ft. per day contract for coke oven gas from the Steel Company of Wales, a new 6 mill. cu.ft. per day water gas plant planned for Port Talbot, and the existing c.v.r. at Neath and Port Talbot. A pre-vesting day contract with the Steel Company provided for an increase of gas supply to 600,000 cu.ft. per hour (14 mill. cu.ft. per day) by January, 1956. The contract was based on a calorific value of 500 B.t.u. per cu.ft., and an additional contract covered a supply of blast furnace gas up to 50,000 cu.ft. per hour for control of calorific values, after purification, to the declared value of 475 B.t.u. per cu.ft.; this was later increased to 150,000 cu.ft. per hour.

Oxide purifiers

The Aberavon gasworks at Port Talbot is being developed for purifying and compressing this gas to a capacity of 45 mill. cu.ft. per day. Among the plant installed is a 6 mill. cu.ft. per day set of Gastechnik pelleted oxide purifiers to be brought into operation in 1959—designed as the first stage of a 10 mill. cu.ft. per day installation with ground space left for a further 10 mill. cu.ft. per day extension as required. Peak loads are met by two 3 mill. cu.ft. per day c.w.g. sets designed to gasify a range of feedstocks from heavy oil to refinery gas. More recently arrangements have been made for liquefied petroleum gas storage for emergency and short-term peak standby.

In 1956 negotiations with the N.C.B. resulted in a scheme for the supply of firedamp from three collieries in the Afan Valley, 16 miles north-east of Port Talbot. The contract quantity was 7 mill. cu.ft. per week of 100% methane equivalent at 995 B.t.u. per cu.ft., the limiting acceptable c.v. being 500 B.t.u. per cu.ft. at any one colliery provided that the c.v. from the three collieries did not fall below 550 B.t.u. per cu.ft.

The firedamp (methane mixed with air and a small amount of CO_2) is extracted, under vacuum, through boreholes drilled into the loosened strata above and below the advancing coal face. Automatic devices give audible warning when the c.v. of the methane/air mixture falls

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below 550 B.t.u. per cu.ft., and ensures a stoppage of the exhauster and closing of master valves on the drainage system if it falls to 530 B.t.u. per cu.ft. The firedamp is received at Aberavon through a duplicate set of filters, non-return valves and flame-traps before reforming or mixing with coke oven and blast furnace gas at inlet purifiers.

South Wales as a whole.—The combined figures for South Wales are tabulated.

The combined estimated average summer demand of 57 mill. cu.ft. per day in 1970 is practically covered by the present basic availability of 56.3 mill. cu.ft. per day, so that additional gas-making capacity for some years to come will be limited to winter- and peak-load requirements with some standby provision.

Development

Anticipated future development of supplies will follow the lines:—

(1) Further firedamp drainage schemes, the current estimate of available supplies being equivalent to 15 mill cu.ft. per day of grid gas.
(2) Increase in coke oven gas supply including the provision of additional plant, probably slagging-type producers for underfiring—such producers would increase availability by 16 mill. cu.ft. per day.
(3) Additional peak-load oil-gas plant in the Eastern Section and possible use of oil refinery gas at Port Talbot.
(4) Increasing the capacity of existing gas manufacturing plants by the use of light hydrocarbon feedstocks for c.w.g. and vertical retorts.
(5) The construction of major production stations based upon out-of-balance products from oil refineries and possibly low-grade coal, principally to provide gas for exports to other area gas boards.

North Wales.—In the year ended March 31, 1951, the total output of the 33 undertakings in North Wales which had been making gas at vesting day was equivalent to 2,400 mill. cu.ft. of gas at 500 B.t.u. per cu.ft. At vesting day new c.v.r. were being erected at Connah's Quay and Denbigh; additional c.v.r. were on order for Colwyn Bay and a Tully plant was being erected at Caernarvon; a chamber oven plant was on order for Wrexham. With the exception of Holyhead and Holywell all the larger undertakings were operating under difficulties.

Early Development.—After vesting day the Wrexham scheme was amended in favour of a new works of larger capacity to be erected at Maelor, a new site some 3½ miles east of the town. Grid mains were planned to supply the small undertakings to the north.

The c.v.r. plant at Conway was getting beyond repair and a measure of reconstruction at Llandudno enabled Llandudno and Colwyn Bay to take over the demand when production ceased at Conway in 1951.

Integration.—In 1951 an examination of possible schemes for the integration of the undertakings from Wrexham to Caernarvon favoured the one based on methane from Point of Ayr, c.v.r. at Colwyn Bay and the new works at Maelor. In 1953 agreement was reached for a supply of unpurified coke oven gas from John Summer's steelworks at Shotton. The extension at Colwyn Bay was cancelled.

The Maelor works was completed in 1953 with a designed capacity of 3.5 mill. cu.ft. per day from an initial installation of intermittent vertical chambers and two c.w.g. sets from the original Wrexham works. The verticals are operated to produce a straight coal gas at 595 B.t.u. per cu.ft. which is diluted by producer gas to give 2.6 mill. cu.ft. a day at 500 B.t.u. per cu.ft. In 1957, arrangements were made to take firedamp from Bersham colliery, five miles away. The daily supply has risen to 470,000 cu.ft. per day at 670 B.t.u. per cu.ft. The effect upon the composition of town gas with various combinations of the gases available at Maelor is tabulated. The mixtures keep the specific gravity of the finished gas in the range 0.47 to 0.58 with a calorific value of 500 B.t.u. per cu.ft.

Revised contract

The contract with John Summers was revised in 1958 to cover the supply of 5 mill. cu.ft. of gas per day of unpurified coke oven gas diluted by blast furnace gas to a c.v. of 520 B.t.u. per cu.ft. Final control down to a declared standard of 500 B.t.u. per cu.ft. is at present effected by air addition for purifier revivification. The existing purifier boxes were transferred from Swansea, but the new contract has enabled the Board to place an order for a Gastechnik pelleted-oxide plant with a designed capacity of 6 mill. cu.ft. per day. Provision is also being made for 50-ton butane storage to bring the peak-load capacity of the Shotton station up to 8.5 mill. cu.ft. per day. Four compressors are installed here each capable of compressing 85,000 cu.ft. per hour of gas to 150 lb. per sq. in.

The whole installation is described in detail in Appendix 1.

Point of Ayr colliery has been well-known for high rates of methane emission for over 70 years. Experience has shown that for satisfactory recovery from a virgin seam, the seam had to be drilled into from a seam or drifts driven above it. First used for boiler-firing, the methane was supplied to the Gas Board under an agreement of 1954. The contract was for a period of 20 years and covered the supply of 4.25 mill. cu.ft. per week at a calorific value of 980 B.t.u. per cu.ft. Payment is on a thermal basis with the proviso that the Board had the right to reject gas under a daily average of 830 B.t.u. per cu.ft.

The Point of Ayr colliery is unique; the methods of methane drainage are quite different from those used in other coal mines. The complete installation for the reforming and other treatment of the firedamp, with compressors and other equipment, is described in detail in an appendix. Details of operating experience and results are given in the paper.

Gas Availability in North Wales.—The maximum availability of gas from the above three sources with c.w.g. reserve is 11.3 mill. cu.ft. gas per day at a calorific value of 500 B.t.u. per cu.ft. against a planned total of 16.3 mill. Shotton and Maelor are interlinked through the existing grid mains and the development of Shotton and Point of Ayr provides time in which to plan the development of Maelor in line with development for Central Wales. The problem of providing complete interchangeability of gases from the three different types of station is realised. Consumer satisfaction has so far been achieved, but continuing attention is being given to further improvement in interchangeability.

The capital cost of the major supply stations in North Wales is set out in Appendix 3.

Conclusion.—Present quantities of methane available are relatively small. The main purpose of methane drainage is to promote safe working conditions in the mines. Nevertheless, the promotion of a methane grid appears to offer possibilities for the recovery of a considerable amount of fuel which would otherwise be blown to waste.

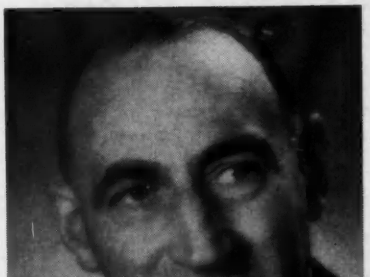
Not fantastic

Reference is made to co-operation with the oil refineries in handling out-of-balance products with quantities of gas involved amounting to 50 or 100 mill. cu.ft. per day. This development cannot be regarded as any more fantastic than the thought of one gas grid serving the whole of South Wales would have seemed to the Wales Gas Board's predecessors at Rhymney and Aber when they made their first coke oven contract for an experimental period of six months in 1907.

AT THE MEETING . . .

F. J. Denny (Ipswich) and Denis Whiteley (Newton Chambers).

TRANSMISSION OF GAS IN WALES



By W. T. HIRD,

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'GAS JOURNAL' abstract

Communication No. 548

THIS paper deals with developments in Wales since 1953 particularly in the lay-out, design and construction of pipe-lines to operate eventually at pressures up to 250 lb. per sq. in. At present 607 miles of transmission lines are in operation in three sections: 175 miles in South Wales Eastern, 233 miles in South Wales Central and Western, and 199 in North Wales. Starting in South Wales before vesting day, 1949, about 182 miles of pipe-line had been laid when, in the middle of 1953, negotiations were completed for the purchase of considerable additional quantities of gas in South and North Wales.

[The lay-out of the South Wales grid in 1959 is shown in Fig. 2 and that of North Wales in Fig. 3 of the paper.]

South Wales.—For the design of the South Wales grid as described in 1952 the most economic transmission costs were obtained by large-diameter pipe-lines with pressures up to 33 lb. per sq. in. Spun iron pipes with flexible joints were used except between Swansea and Llanelly where steel was used to allow for possible future re-compression at Swansea. Westward from Llanelly steel pipes were used with sizes, 8 in., 6 in., and 4 in., calculated on the basis of initial demand plus 50% with pressure at the re-compression station at Llanelly, on the maximum day of the initial demand, at 75 lb. per sq. in. The pipe-line was designed for an ultimate maximum operating pressure of 250 lb. per sq. in. when an increase of about 400% in demand could be met.

North Wales.—For this scheme also steel pipes, calculated on a similar basis were adopted. A system of 12-in., 10-in., 8-in., 6-in., and 4-in. diameter pipe-lines, operated on the maximum day of initial demand at 50 lb. per sq. in. in pressure, raised to 250 lb. per sq. in., the system would transmit about 500% of the initial demand.

Peak-load plants

In both schemes it was considered that the demand should reach 400 and 550% respectively of the initial level, further development could be met by installing peak-load plants at the ends of the pipe-lines and that, even before the full capacities of the pipelines were absorbed, such plants might be economic to meet seasonal peak demands.

Pipe-line specification.—Following the author's visit to the U.S.A. as a member of an O.E.E.C. mission to study 'Long-distance Gas Transport,' it was decided to use steel pipe manufactured to the American Petroleum Institute 5L (Grade B) Specification, with steel of tensile strength of 60,000 lb. per sq. in. and a carbon content not exceeding .27%. Operating pressures of the order of 250 lb. per sq. in. are low for this quality of pipe; wall thicknesses depend rather on problems of handling and welding than on the safety factor.

Contrary to U.S.A. practice in which pipes are not coated internally, it was decided that the pipes should be phosphate-treated, descaled, and coated internally with red lead oil paint—but pipe-lines were constructed to allow the future use of cleaning 'pigs,' should this ever prove to be necessary. Pipes were delivered with an external coating of primer suitable for coal-tar enamel; they were to be covered, either by continuous line-wrapping machines or at site wrapping plants, with coal-tar enamel reinforced by glass-fibre tissue to a specification based on American experience.

Pipes were to be electrically butt-welded. No mitre welds would be permitted and bends would be produced either by cold-bending in the field or by factory-produced bends. Welding was to conform to the American Petroleum Institute Specification 1104, with suitable modifications.

Pipe-lines were to be contour laid with the exception of the first three or four miles from after-coolers at compression stations which would be laid to a grade (fall) with siphons to collect condensates. On the contour-laid sections drainage points were to be fitted only in deep valleys.

Pipe-line valves, with cast or forged steel bodies suitable for welding into the line without flanges and with 'full-bore,' were specially designed by the Bryan Donkin Co., Ltd., who produced their Fulbor valve to meet the requirements. Valves were to be fitted at intervals not exceeding five miles. Pressure test points at all ¼-mile intervals were so designed that they could also be used as corrosion test points. Expansion joints were not used; American experience is against them. 'A much preferred practice is to ensure that the line is laid in compression by laying in the trench as much extra pipe as possible by looping.'

Construction method.—To meet obligations to take gas under the new contracts, the construction of 101 miles of pipe-lines in North Wales and of 28 miles in South Wales had to be completed in a period of two years, including the lengthy period of delivery of pipes. It was, therefore, decided to examine the possibility of using the technique developed in the U.S.A. for the construction of long pipe-lines. Construction is broken down into a series of separate operations, each self-contained in men and plant and equipped for equal daily progress. Twelve separate operations are outlined, from clearing the right-of-way to ditching, placing and preparing the pipes, lowering in, back-filling and cleaning-up. Important among the techniques and machines adopted from the U.S.A. are—'downhand' welding, two welders working simultaneously and welding from the top of the pipe downwards on each side—trenching machines, of the 'wheel' type, capable of digging two miles of trench per 8-hour shift (supplemented by the use of 'back-acters' and by blasting in rocky sections)—machines that travel along the pipe-line, cleaning and priming and, as a separate operation, coating and wrapping the pipe, up to four miles of pipe-line coating per day being possible.

One contract

To justify the importation of the American machines it was decided to make one contract, awarded to Costain-John Brown Ltd., now Constructors-John Brown Ltd., of the 196 miles of pipe-line required in North and South Wales as the initial result of the gas purchase contracts made in 1953.

Construction.—The programme, beginning with route surveys and wayleave negotiations, opened in 1954. It is set out and described in detail. Work, mainly for training purposes, began in the autumn and winter of 1954-55, but experience showed that the work should be carried out in summer, beginning as soon as ground conditions permitted and finishing in the autumn. The line in North Wales was put into operation on November 23, 1955, six weeks ahead of target date. It had been laid at an average rate of 3½ miles per week with a maximum over five miles in one week.

Estimated and realised costs are tabulated, together with those of smaller diameter pipe-lines included in the pro-

gramme of branch lines and extensions carried out in 1956-57 and 1958.

Methane.—Following the agreement with the National Coal Board to take methane from the Point of Ayr colliery, further agreements were made for the purchase of methane/air mixtures drained from coal mines in North and in South Wales. In North Wales a five miles long pipe-line is delivering 3 mill. cu.ft. per week of the mixture at a c.v. of 670 B.t.u. per cu.ft. from Bersham colliery to Maelor gasworks. In South Wales, 16 miles of pipe-line, from 12 in. to 6 in. diameter collects gas from three collieries in the Afan Valley for delivery to the Aberavon works where up to 24 mill. cu.ft. of coke oven gas is purified and compressed daily for the gas grid. This line, designed for extension to further pits, at present delivers 12 mill. cu.ft. per week at a c.v. of 590 B.t.u. per cu.ft. to Aberavon.

These pipe-lines, similar in specification and construction to those already described, are designed to operate at a maximum pressure of 100 lb. per sq. in. but operate at present at pressures up to 20 lb. per sq. in. Ultimately about 120 miles of pipe-line will be required to collect an estimated quantity of methane equivalent to 15 mill. cu.ft. per day of town gas at 495 B.t.u. per cu.ft.

Re-compression.—It is necessary to re-compress the gas required for the Western section of South Wales, from Llanelly to Pembrokeshire, from the 33 lb. per sq. in. of the Central section to a present maximum of 70 lb. per sq. in. Two compressors are installed at Llanelly, one electrically and one diesel driven, each of a capacity of 80,000 cu.ft. per hr. at an outlet pressure of 107 lb. per sq. in. Either unit will take over automatically from the other in the event of power failure or mechanical breakdown. Similar but smaller machines are installed at Ammanford and Abergavenny.

Adequate pressure

In North Wales, the pipe-line pressure is adequate for all the branches. Calculations showed that for present demand and for estimated intermediate and ultimate development of demand, the most economic operation would be obtained with gas all compressed at the sources only, *i.e.*, at Shotton and Point of Ayr.

Metering and governing.—Control of gas into receiving stations in the Eastern and Central sections of South Wales is by conventional, diaphragm-type, volumetric governors and positive-displacement meters, but for the pipe-lines designed to operate at pressures up to 250 lb. per sq. in. orifice meters are used. Initial results have indicated that an accuracy of about .5% can be obtained with the latter provided that accurate records of pressure, temperature and specific gravity are available and full corrections made.

Cathodic protection.—Cathodic protection is operating on 240 miles of the high-pressure steel pipe-lines constructed. Installation on a further 116 miles is in progress. A summary of the results is tabulated. It is interesting to note that the Shotton-Caernarvon section, coated by the continuous line machines, requires the lowest current density per sq. ft.; this result supports the contention that better coating is obtained by that method.

Supplies direct from the pipe-lines.—The Board does not refuse requests for supply of gas direct from the pipe-lines where no economic alternative is available; even compressor load factor is maintained by utilising holder storage at receiving undertakings at peak periods.

New supplies

Supplies have been made available to landowners and tenants along the pipe-lines. The Board makes tappings in the pipe-lines as part-payment for wayleaves. Supplies have also been made available to a number of villages which had no previous gas supply. Isolated industrial undertakings have also been supplied in this way. The ability to accept direct supplies will be increased when the planned system of remote indication and operation, using ultra high-frequency radio, is installed.

Financial and commercial results and transmission costs are tabulated. More competitive tariffs and improved supply has led to increased sales. The total sale of gas in 1958 by the North Wales undertakings supplied in the initial stage of development is 10% greater than in 1953. The sale of gas by the six undertakings west of Llanelly has increased in the same period by 20%.

Conclusion.—The estimated cost of gas into holder in 16 cases and comparing that of manufactured gas with l.p.g./air and gas from the grid is shown in a graph. It is seen that the construction of a pipe-line to supply these 16 undertakings results in a higher average cost into holder at the present level of demand, but that a lower cost quickly results from a growth in demand, parity being reached with an increase of 2%.

To supply these undertakings it will be necessary to construct 210 miles of small-diameter, high-pressure pipe-line, capable of meeting a fourfold increase in demand by designing it for a maximum working pressure of 400 lb. per sq. in. A more detailed study will be necessary before a final decision is reached whether some or all of this group of undertakings should be supplied in this way, but recent experience suggests that pipe-line gas, both technically and commercially, may well provide the best solution to the problem.

96th A.G.M.

PURIFICATION PLANTS AT CARDIFF

Continued from p. 461.

ment. The resultant screenings, being highly reactive material, are transferred for use in conventional box purifiers.

To recover sulphur from the pellets after fouling and revivification, the material is charged into extraction vessels where the sulphur is extracted by perchlorethylene (C_2Cl_4) at boiling point under slight pressure.

Generally, six extractions with the solvent are necessary to reduce the pellet sulphur content to between 3 and 5% by weight. Each complete extraction cycles takes 195 minutes, there being six extractions per cycle. The first or 'dewatering' extraction, takes about 45 minutes, when pellets have the usual 2% moisture content. This first wash is terminated when water ceases to flow from the primary separator. The other five washes last 30 minutes each. During the first extraction, most of the water in the pellets is boiled off and comes down in the condenser. After each of the first four washes, pressure in the extractor is allowed to build up to approximately 12 lb. per sq. in. gauge to force the hot dissolved sulphur/perchlorethylene solution through a filter and up into the still feed tank—this technique is considered to be more economical—while the liquid from the last two extractions, being low in sulphur content, is fed to the extract feed tank ready for use on the next batch of pellets. The four washes of hot solution are distilled and condensed. When perchlorethylene cases to flow from the primary separator, live steam is injected at the base of the still to drive off any trace of perchlorethylene in the sulphur, which is then run off into moulds.

The molten sulphur is discharged from the stills into trays, where it solidifies into 80 lb. blocks having the following typical analysis:—

	Per cent.
Sulphur	98.0
Inorganic material (oxide)	0.8
Carbon (as bitumen) ...	0.7
Chlorides	0.1
Arsenic	0.00015

The drained pellets, in the extractor vessels, are live-steam-heated to vaporise traces of perchlorethylene, remaining in the pores of the pellets prior to their discharge into the handling skips.

For removing hydrogen sulphide, the Gastechnik towers have proved to be extremely efficient and reliable, with the added merit of being able to sustain high overload conditions (up to 100%) for long periods (two weeks) when the rate of pellet charge is proportionately increased.

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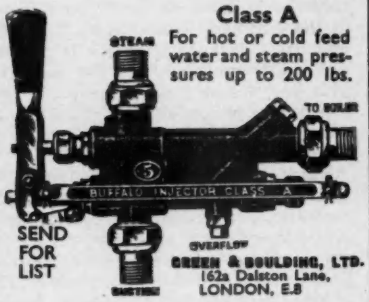

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APPOINTMENTS VACANT

SOUTHERN GAS BOARD
A SENIOR HOME SERVICE ADVISER.

SENIOR Home Service Adviser required in Reading Region of Southern Gas Board. Applicants should be between ages of 25 and 35 and should have had two years' full-time training at a College of Domestic Science recognised by the Ministry of Education, and hold a Diploma from that College, or equivalent qualifications.

The successful applicant will be required to conduct demonstrations and give lectures, and advise customers on the correct use of gas equipment. She will also be responsible for the control of other Home Service Staff and the planning of Home Service activities in the Reading Region.

The appointment will be within Grade A.P.T. 6 (£628-£702) of the Salary Scales of the National Joint Council for Gas Staffs, and the successful candidate will be required to pass a medical examination and to join the Board's Staff Pension Scheme.

Forms of application may be obtained from the Personnel Manager, 164, Above Bar, Southampton, to whom they should be returned by June 26, 1959.

SOUTH EASTERN GAS BOARD
INSTRUCTOR IN MAINS AND SERVICE LAYING.
PERSONNEL MANAGER'S DEPARTMENT.

APPLICANTS should have extensive practical experience in all types of mains and service laying work, and be capable of instructing new recruits and of giving refresher courses to existing personnel. A Higher National Certificate or equivalent qualification would be an advantage but is not essential. The duties will be mainly concerned with instruction in mains and service laying by means of practical demonstrations and lectures to be given at a Training Centre situated at Old Kent Road, London, S.E.15. When not required for these duties the successful applicant will be expected to undertake operational or technical work under the direction of the Chief Distribution Engineer. Salary not less than Grade 8 (Met. Area), minimum £808 per annum. Applications in writing, quoting Reference V10/1054 and giving full details, to Personnel Manager, South Eastern Gas Board, Katharine Street, Croydon, Surrey, within fourteen days.

THE SCOTTISH GAS BOARD invite applications for this Post: WORKS SUPERINTENDENT at GREENOCK GAS WORKS.

The successful applicant will be responsible to the Station Engineer for the control of all production and labour. Should possess the Higher National Certificate in Gas Engineering, Chemistry, or Mechanical Engineering, and possess corporate membership of one of the Engineering Institutions. Previous experience in the control of labour is essential. A detached house may be available for rental. The post is remunerated within Grade A.P.T. 9. Provincial A £827-£927 per annum with placing therein according to qualifications and experience. Applications should be marked WSG and reach the Personnel Officer, The Scottish Gas Board, Dept. GJ., 9, George Square, Glasgow, C.2, not later than July 6. Both posts are pensionable and successful applicants will be required to pass a medical examination. State age and give particulars of education, training, qualifications and experience.

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